THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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MODERN STREET LIGHTING.

LAST WEEK Mr. Haydn Harrison presented to the Institution of Electrical Engineers a paper on recent developments in street lighting by electricity, of which an abstract is given elsewhere in this issue. This most valuable contribution to our knowledge of an important subject should claim the attention of every engineer interested in the public supply of electrical energy.

Dusk to dawn lighting offers a load factor of 40 %, and when it is carried out with high-grade arcs and metal-filament lamps, the incidental trouble and expense is less than that connected with any other supply. On the cost of renewals and maintenance, Mr. Harrison gives valuable data, and shows that no undertaking need hesitate to make a bid for the local street lighting business on terms which will cover running costs, and the fixed charges upon the plant taken up by the lamps to be connected. The advertising value of public lighting well carried out is very great, as may be inferred from the strenuous efforts made by the gas companies to retain it, although their directors often explain that its loss is a small matter, as it constitutes no more than 2 or 3 per cent. of their total revenue. In the present state of development of electric supply undertakings the revenue to be derived from the local public lamps will generally be found to average from 10 to 15 per cent. of the total revenue of the undertaking, the maximum demand being about 5 to 10 per cent. of the total maximum.

Certainly no local authority should, at the present time, commit itself to long contracts for gas lighting where there is any possibility of utilising electricity. The falling cost of production in electricity works, and the great advance in the manufacture of lamps and fittings, render it every day more desirable for all public lighting to be undertaken by the local electrical suppliers.

In the author's paper the figures given for lamp renewals in estimates prepared in connection with the Marylebone conversion appear to be low, and for lamps burning singly across 200 volts and upwards would be more safely taken at 50 per cent. above those quoted. The influence of working pressure upon the life of tungsten lamps is still very considerable, the lower voltages giving a much more durable lamp, and also reducing those breakages which take place, when the lamps are not burning, as a result of handling and vibration.

On high-voltage direct current circuits the superiority of the low-voltage lamps is to some extent discounted by the need of burning in series pairs, but where alternating current is available it is worth while to reduce the pressure by means of auto-coils or balancers where lamps aggregating 300 or more watts capacity can be fed from one auto-coil.

The question of loans for converting street lighting from gas to electricity is referred to by the author; it certainly

appears a hardship that a supply undertaking should be asked to carry out permanent works at the expense of revenue, but it must be borne in mind that in some cases the change involves the replacement of lighting appliances which have become obsolete, and considerations of this kind no doubt influence the L.G.B.

Whether such work is carried out with borrowed money or charged to revenue, it should be done thoroughly, with apparatus of the best design; the conversion of existing gas lanterns is seldom justified, often ugly, and deprives the undertaking of much of the advertising effect secured by the change in form and appearance of the posts.

The high-candle-power tungsten lamp lanterns should have a wide sphere of usefulness; they afford a powerful light without glare, falling off very evenly as the distance from the post increases. When pitted against old type open and enclosed arcs the result is entirely in favour of incandescent lanterns, and in many situations where arc or trolley posts are to be found spaced up to 80 yards apart these lanterns afford a ready means of improving illumination and reducing costs. For shopping thoroughfares, except in very small towns, it is to be doubted whether the capacity of these lanterns is sufficient, and it would probably be advisable to design the fitting so that an increase in candle-power could be readily made as the demand for light increased. These groups of lamps have the further advantage that a failure does not mean total extinction, and by suitable switching the light can be reduced after a certain hour of the night.

Where the magnitude of the undertaking warrants it, the use of separate cables for the public lamps has distinct advantages, enabling them to be switched on and off in groups, and avoiding the necessity of making hundreds of small service connections to the distributors. Where, however, this cannot be done, all new distributing cables, laid in districts where public lamps are likely to be connected, might be provided with an insulated switch wire which would allow of groups being worked from a central point. The increase in the cost of low-tension concentric cables, due to the provision of an insulated strand for this purpose, would not exceed about 5 per cent. on the total.

The study of illuminating problems has naturally led to the conclusion that for the purposes of traffic uniform lighting over the whole of a thoroughfare is the ideal to be aimed at; yet the gas companies, who were prompt to point out that their numerous small lamps gave a more regular distribution of light than the flame arc lamps, now expend much trouble in attempts to produce lamps of very high candle-power. It appears obvious that to give general satisfaction something of scientific fitness must be sacrificed to the desire for cheerful glow and the play of light and shadow. Daylight is perfect and uniform, but daylight imitated with the comparatively low illuminating powers at the disposal of man, though it might be effective and economical, would be as cheerless as a Northern twilight.

The Imperial Telegraph Service.

It is satisfactory to observe that steps are again being taken to advocate the completion of an Imperial telegraph service, and it is believed that the Governments of Australia and Canada are seriously considering the proposal to establish a State-owned cable between this country and Canada by way of the Faroe Islands, Iceland, Greenland and Labrador. From details published in the *Times* last Saturday, it appears that this northern route has the advantage over the existing mid-Atlantic route, both as regards the diminished total length, and as regards the fact that the intermediate stations would enable the distance to be sub-divided. The longest section would be between Iceland and Greenland, a distance estimated at 670 miles. This section would, of course, determine the speed of working; and if that speed were kept down to the working speeds of existing Atlantic cables, the core of the Iceland-Greenland section could be of considerably lighter type than that of the mid-Atlantic cables, with consequent great reduction in cost of the undertaking. The section from the North of Scotland to the Faroe Islands is given as 225 miles, and from the Faroe Islands to Iceland the distance is about 240 miles. For these sections, therefore, types of conductor and dielectric could be adopted even lighter than those needed for the Iceland-Greenland section. Again, the final section, from Greenland to Labrador, is estimated at 510 miles, and it is possible that some reduction of weight could be allowed even in this core as compared with that of the Iceland-Greenland section. From the point of view of effective telegraphy, it is noteworthy that the estimated total length is only 1,645 miles, as compared with something like 2,000 for the mid-Atlantic cables. The margin can be interpreted in terms of increased speed of signalling, or as diminished cost, whichever best suits the needs and the pockets of the Governments concerned.

The seas that touch upon the shores of Iceland, Greenland, and Labrador, are not remarkable for their insolation. They are bracing rather than salubrious; and for the greater part of the year they are obstructed locally by ice in its various forms and conditions. Providentially for the cables, the ice prefers the surface to the bed of the ocean. It follows, therefore, that when once the cable is laid, risk of fracture from the mechanical action of the ice is improbable, and that the only positions calling for special precautions on account of the ice are the places of landing. The modern heavy shore-end cable can, however, be regarded as adequate to safeguard the service against any ordinary ice dangers of this character. Care would, of course, be necessary in selecting the best time of year for laying cables in those seas; but when the difficulties that have been overcome by the staffs and the crews of telegraph ships are called to mind, it is obvious that there is no reason to doubt that such a cable could be laid and maintained with complete success. Repairs would require special consideration, for, as stated in the *Times*, "the ice in the northern latitudes will probably render repairs on about a third of the total length impossible during about eight months of the year." It is, however, pointed out that in the remaining period, when the repairing ships could reach these latitudes in safety, the cable ships could quickly and easily effect the repairs. Inspection of a chart shows that the cable could be laid at moderate depth throughout the greater part of its whole length—a fact that renders repairs a much simpler and cheaper matter than repairs in the vast depths of the mid-Atlantic and Pacific. Nevertheless, it must be admitted that eight months would be a long period for enforced discontinuity in an Imperial cable, and the route would thus probably require for safety a duplicate cable as a measure of precaution.

It is certain that to enable the transmission of telegrams to proceed as cheaply as the circumstances demand, between Great Britain and the Colonies, a vigorous step of the kind here adumbrated is absolutely necessary. The *Times* points out that the Atlantic cable rates have for 23 years remained at a shilling a word, and that if allowance is made for the landline charges, the Atlantic cables still absorb rather more than half the total charge for a Press message between England and Australia. From the commercial stand-point, the retarding influence of these high rates can scarcely be over-estimated; for Canada has the United States at her very door, with means of rapid communication at negligible cost for the ordering of goods. Great Britain is thus at enormous disadvantage as compared with the United States in such negotiations; and in view of the United States' heavy tariffs, there is no compensating advantage to set against it. From every point of view, therefore, the scheme deserves the support of all who think imperially, and all who look ahead, keeping in mind the part that the Empire's cables are destined to serve in the Empire's crucial hour.

THE SUPPLY OF LAMPS BY ELECTRICITY WORKS.

By "METAL."

That the function of an electric lighting station—and lighting still remains the most important side in the majority of stations—is to provide light rather than current, is a platitude the importance of which is not sufficiently realised. This fact was brought prominently to my mind when hearing of a large town, where, even now, disconnections of lamps are nearly equal to connections, although the juice is sold at low rates. Experience has proved that energetic and useful attention to existing consumers is probably the most powerful means of extending the use of electric light to new people, far better indeed than the circulation of numberless leaflets and other such literature, for the usual style of such things often deepens the disgust of a man who has a bad light, in spite of some casual and ill-directed efforts to improve it. The station must supply lamps to consumers if the best is to be got out of the electricity supply, and the suppliers of current must arrange to do the thinking for their clients, as much as ever they can at any rate. This means a lamp supply scheme.

Many methods have been tried for the supply of lamps, but with varying success. Some stations have given up the attempt because it was too costly, or because it required too much labour to carry it out properly. Some tried replacing worn-out lamps free, but this was often abused by dishonest people who still, unfortunately, exist in most towns. Others provided lamps at so much per holder per quarter, but this plan required an immense amount of book-keeping and inspection, while there was serious difficulty in making a rate which should be at all reasonable. Differences were made between the charges for bedrooms and living rooms, but this allowed opportunity for wrangling, for why should a bedroom, used as a study, get a cheap rate, while the drawing room, only used on state occasions, was charged at full prices? Then unreasonable consumers made a point of changing their lamps often, merely to get their money's worth. One man—in an office—told me he had changed his lamps three times in a quarter for this purpose. No wonder the authorities dropped their lamp renewal scheme in that town!

One plan, tried by a number of stations, is to allow a lamp for a specified number of units consumed. This does not meet the needs of the consumers who usually require the lamps, which are used for similar hours, to be renewed at the same time, instead of being sent up in driblets as happens under this arrangement. Of course the lamps may be stored away in drawers when sent up by the station, but likely as not they will be found broken when wanted. All the above methods have also the fatal disadvantage that they only provide carbon lamps, whereas people want metal lamps. It may therefore be of interest to give details of a scheme which has worked well for some years, proving of the utmost value to the station in which it is used. It requires little book-keeping, and no more inspection than is required by the consumers, which is much to be desired by ladies who do not like men, coming off dirty streets, to go over their good carpets counting up lamps, &c. The consumer under this arrangement has the option of entering into an agreement with the station, whereby, in return for giving up his cash discount of 5 per cent. on his account for current, he receives lamps as required at cheap rates. The lamps are thus partly paid for by cash and partly by the 5 per cent. discount given up on the electricity bill. To ensure that accounts are paid in a reasonable time, the lamp account is subject to 10 per cent. discount provided that it and the electricity bill are paid by the time stipulated. Prices for lamps of all kinds are kept at the lowest possible rates, and altered from time to time to suit developments. The actual prices charged must be a matter of policy, but it is probably a good thing to keep them low, even if it means an actual loss on the supply. Certainly it is better to do this than to reduce rates for current, while it is often just as efficient a means of getting more consumers and of keeping existing connections. Where a lamp has a short life it is replaced free, a benefit much appreciated by people who hate to pay 4s. for a lamp which has only lasted a day or so under treatment which, to the ordinary mind, seems reasonable enough. Fuses are replaced free, and small attentions are given, after the manner of gas companies. An assistant is kept at the station for such work during evening shift, a very needful thing if tragedies are to be avoided amongst the consumers, for where a draper's sale or a bridge drive is spoilt through a blown fuse, damage is done to the undertaking that much canvassing will not repair. Indeed, a flow of literature may simply irritate people who have unrelieved complaints to make about their supply. Where possible, people are persuaded to take down the flower-pot type of shade, and replace them by Holophane reflectors. (It would be a good thing if people could arrange to put up dummy fittings to take the so-called beautiful shades of which ladies are so fond, the real fittings having Holophane reflectors to light the room properly.)

In the writer's case, the lamp renewal scheme, along with attendance on consumers, has been of the utmost advantage to the undertaking, probably even its salvation. Metal lamps have been pushed from the beginning, so that the change has come gradually, and not in a flood, while the canvassing department has also received the greatest assistance from its operation.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Extending British Engineering Abroad.

I am very pleased to see that the urgent necessity for a manufacturers' combine, having for its objects the preservation and expansion of our foreign trades, to which I drew attention in a letter which you courteously published in your issue of April 29th, is at last attracting the attention of correspondents in the technical Press, and it is to be earnestly hoped that the able article from the pen of Mr. E. T. Williams, published in your last issue, will induce manufacturers to seriously consider the formation of some kind of organisation which will, at least, place them upon an equal footing with their foreign competitors.

That there are many difficulties to be overcome, and individual interests to be adjusted, before such an organisation could be successfully started, nobody will dispute, but that such difficulties and conflicting interests are not insurmountable obstacles is proved by the success of manufacturers' organisations in America and Germany.

I cannot claim to have had experience over such a large area as Mr. Williams, but from several years' experience in India, I can confidently state, without fear of responsible contradiction, that a scheme such as that outlined by Mr. Williams, would result in enormous benefits to British trade.

As Mr. Williams truly states, there are many ways in which combined action could be taken, but whatever is done, great care should be exercised not to disturb, or divert, the trade which has been built up, and is now in the hands of our agents and representatives abroad. To them in no small degree we owe, and must continue to owe, whatever success we have obtained, or may obtain, abroad, and therefore, while it is imperative that manufacturers should organise and combine for the purpose of expanding their foreign trade, their efforts should, to a great extent, be directed to assisting those representatives, and not to competing with them.

In my letter referred to above, I suggested as a possible solution of the serious disabilities under which our manufacturers and representatives abroad work, the establishment by an association or group of manufacturers of commercial consulates, in all important countries, officered by practical commercial and technical experts, who know the language and people of the countries to which they are appointed, whose sole business it should be, without actually trading, to systematically advertise and push the goods of the members of the association, report upon all foreign imports, the extent to which, and the class of people by whom, they are used, prices at which they are sold in the local markets, and wherein they differ from British goods.

D

The above is a direction in which, I think, an inquiry into the possibility of organising our foreign trade might profitably be pursued, but it should be supplemented by permanent exhibitions, in all important centres, of the goods manufactured by the various members of the Association, to which people of all classes should be admitted. Prices could be quoted, and comparisons drawn, between the exhibits and similar articles of foreign origin, but in no case should discounts be quoted, or sales made, except to recognised agents or members of the trade, the sole object of the exhibition being to demonstrate to trader and user alike the superiority of British goods.

Such an Association might be recruited from manufacturers in widely differing trades; the engineering, chemistry, cutlery, hardware, textile and furnishing trades could all be represented with equally good results.

Considerable financial sacrifices would undoubtedly have to be made by the members of the Association, and no doubt the proportion to be paid by different members would require some careful adjusting; but given a sufficient membership, there is no reason why the expense should be prohibitive, and it would certainly not be disproportionate to the benefits which would be derived.

Finally, permit me to beg British manufacturers to take heed of the warning contained in the last paragraph of Mr. Williams's article. Other countries are organising their foreign trade, and already American manufacturers have established, with good results, a small permanent exhibition in India, and it is of vital importance that British manufacturers should likewise immediately organise for the purpose of preserving and expanding their foreign trades, unless they wish to lose their foreign markets entirely.

W. Donovan.

Birmingham, *November 29th*, 1910.

Comparative Costs of Running Gas and Oil Engines.

I have a copy of a paper read at a meeting of the Institution of Mechanical Engineers, held at Leeds in July, 1903, by Mr. H. Ade Clark, on the Diesel engine, giving comparative costs of Diesel, gas and steam engines, both capital and running costs.

Perhaps some of your readers have some results of their own tests, or they may be able to refer me to some more recent published figures? I should be very glad of any reliable information on this subject.

J. H.

[See "Diesel Plant at Saltburn," Elec. Rev., August 12th, 1910, p. 262; also Mr. A. J. J. Pfeiffer's I.E.E. paper on "Comparisons between Steam, Gas and Oil Engines," Elec. Rev., June 11th and 25th, 1909.—Eds.]

Motor-Car Lighting.

We beg to call your attention to what we believe to be a small inaccuracy which has crept into the description of the electrical fittings for cars exhibited at Olympia, on page 819 in your issue of November 18th.

It is there stated that the "Leitner" dynamo was the first machine to be put forward for car-lighting, and we therefore have pleasure in enclosing an illustration of Mr. C. A. Vandervell's patent dynamo fitted to a Daimler car in 1904.

We may mention that these machines are still running satisfactorily, although we have for some time discontinued the manufacture, owing to the rather high cost of production.

C. A. Vandervell & Co.

London, W., *November 24th*, 1910.

Municipal Wiring.

In your issue for November 18th you publish a letter purporting to deal with this subject from the wireman's point of view; that it does not do so will be agreed by all of your readers, who, like myself, have learnt to know and respect the British wireman as a class.

But the serious matter is the statement made—absolutely without foundation—that the Electrical Contractors' Association have a system of "black-listing" men who have in some way offended the members. I am in a position to say that it is only on the report of drunkenness, incapacity, or misconduct on the purchaser's premises, that a wireman is "black-listed," and the only questions ever asked are those made by the secretary of the referees when a man first applies to be put on the register.

The Association have done nothing but help the wireman, and in hundreds of cases have been successful in finding employment for men seeking it.

As regards rates of pay, my own experience is that the well-trained and willing man is always able to demand a higher wage than the so-called district rate, and it is only right that positions under public bodies should be filled by the very pick of the field, and that a higher rate should be paid.

Judging by his literary talent, I assume your correspondent to be one of these, and as representing the mutual interest of employer and employé in this matter, I shall be pleased to meet Mr. Webb at this address to discuss the matter.

Geo. Harland Bowden.

20, Bucklersbury, E.C.
November 29th, 1910.

PROCEEDINGS OF INSTITUTIONS.

Street Lighting by Modern Electric Lamps.

By Haydn T. Harrison, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers, *Manchester, November 22nd, and London, November 24th*, 1910.)

In nearly every town and city of this country gas, being the illuminant available at the time when the streets were built, was naturally chosen for the purpose, and electrical engineers have found that in order to displace it they must be in a position to supply lamps of about the same candle-power either at an equal or a lower cost, as it is often not considered advisable to go to the expense of scrapping existing posts and lanterns. I propose, therefore, to lay before you the figures relating to the borough of St. Marylebone, where the incandescent gas lamps have lately been replaced by electric (tungsten) lamps. An outside testing authority intimately connected with the gas industry was instructed to test at random 100 street gas lamps in the district; the results showed an average of 50 c.p. for the single 4½-cb. ft. gas mantles, and 76·6 for the double mantles. I tested for my own satisfaction and found with the single mantles an average of 45 c.p., and with the double 76 c.p. It was decided that the single lamps should be replaced by two 115-volt 35-watt Osram lamps in series, and the double lamps by two 55-watt lamps.

The existing gas lamp-posts and lanterns being the property of the Council, and having been maintained in good condition, it was decided to retain them. The light from tungsten lamps having a profile curve favourable to street lighting, it was only necessary to accentuate this by means of reflectors; on the other hand, the use of something which would counteract the effect of high intrinsic brilliancy of the light source on the iris of the eyes had proved in my experience a very important point; therefore I submitted a reflector for this purpose which, after slight modification to suit local conditions, was duly approved. This reflector, which is in shape similar to an inverted wedge with suitably curved sides, attained both of the above objects, increasing the candle-power of the rays near the horizontal to nearly double that of the lamps only and to six times the vertical rays. The chief features of the fittings are a large surface of white reflector above the lamp filaments with no intervening lamp caps or holders; anti-vibration holders to protect the lamps; suitable watertight D.P. switches and fuses, and sealing chambers of sufficiently small dimensions to go between the bottom of the lantern and the top of the post. The work of converting 1,964 lanterns and connecting them to existing distributors has been done for £5,788, or an average of less than £3 per post, and was carried through in three months at an average of nearly 200 posts a week without in any way interfering with the continuity of supply to a single customer.

The excellent results obtained have led to the Council deciding to convert the remaining 1,385 lanterns in this district. The 1,964 lamps when lighted by gas cost the Council for gas, lighting, extinguishing, cleaning, and maintenance, £8,818 per annum. The gas contractors when asked for a revised tender reduced their price considerably, but were unable to compete with the tenders of the electricity department, which amounted to £7,350 per annum, made up approximately as follows:—

		Per post.
A. Electrical energy at 1·42d. per unit ...	£3,950	£2 0 0
B. Lighting, extinguishing, cleaning, painting, &c.	1,570	0 16 0
C. Lamp renewals	1,230	0 12 6
D. Repayment of cost of electric fittings in three years	600	0 6 6
Total	£7,350	£3 15 0

The 1,964 street lanterns included in this charge contain lamps of various candle-power; the numbers are approximately as follows:—

	Measured candle-power. At 20°.	At 10°.
385 two 80-watt lamps	135	220
491 two 55 "	75	130
1,188 two 35 "	55	100

In dividing them the proportionate cost of each per annum would be approximately as follows when taking energy at 1·42d. per unit :—

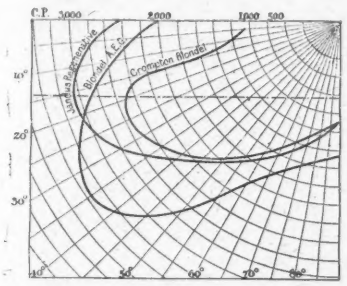
	70-watt.	110-watt.	160-watt.
A	28s. 6d.	45s. 0d.	64s. 0d.
B	16s. 0d.	16s. 0d.	16s. 0d.
C	12s. 0d.	12s. 0d.	15s. 0d.
D	6s. 6d.	6s. 6d.	6s. 6d.
Total	63s. 0d.	79s. 6d.	101s. 6d.

The price charged per unit, 1·42d., was fixed in order to repay the cost of the services at an early date. If the charge per unit were 1d., which is more consistent with the costs of generating, the sum of £3,950 per annum would be reduced to £2,780, which allows £1,170 per annum for repayment of cost of services, &c., the cost of the repayment of the electric fittings being already allowed for; this would easily wipe off the cost of the services in five years; therefore, if a 10 or 15-year loan had been arranged, the price per unit could have been reduced to 1d. per unit, which would work out as follows :—

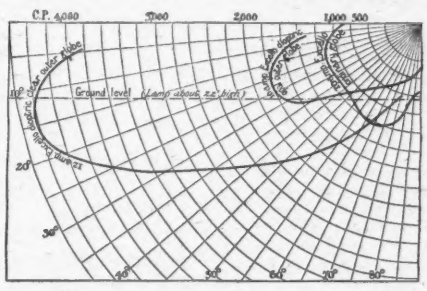
	70-watt.	110-watt.	160-watt.
A. Electrical energy at 1d. per unit	24s. 0d.	38s. 0d.	56s. 6d.
B, C and D. As before ...	34s. 6d.	34s. 0d.	37s. 6d.
Total	58s. 6d.	72s. 0d.	94s. 0d.

Note.—Charges B and C have since been reduced; thus an actual higher rate is being obtained for current.

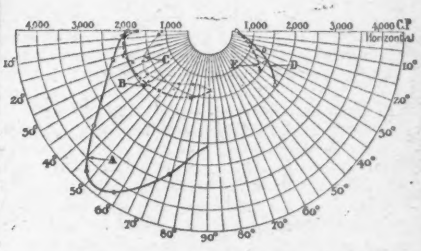
It seems incomprehensible that capital charges connected with the services to street lamps should be dealt with differently to those necessitated by an ordinary consumer, and that the loan for them should ever be refused. As a consumer, a street lamp is very attractive; the load factor is good, no expensive meters or other apparatus are necessary, and it is not likely to have to be cut off owing to termination of tenancy or vagaries of that description.



Curve I.—C.P. Curves of Vertical Carbon Flame Lamps.



Curve II.—Effect of Dioptric and Other Globes.



Curve III.—Beck Flame Lamps.

A, 10-amp., clear globe; B and C, 10-amp., opalescent globes; D, 8-amp., clear globe; E, 8-amp., opalescent globe.

The street lamp acts as an advertisement to the electricity undertaking, and the local authority controls its own public lighting instead of being in the hands of its bitterest opponent. In the case of Marylebone, not only were all these advantages gained, but a large saving—namely, £1,500 a year—was made in the lighting rate, the electricity undertaking benefited, theand illumination of the streets was improved. In the face of all this it would be interesting to know on what grounds the authorities who control the obtaining of loans by municipal undertakings base their antipathy to granting loans for street-lighting purposes.

Original.	C.P.	Replaced by	C.P. at 20°.	C.P. at 10°.
Single gas mantle...	45	Two 35-watt Osram lamps	55	100
Double gas mantle...	76	Two 55-watt Osram lamps	78	130
Double gas mantle...	76	Two 80-watt Osram lamps	135	220

(These tests were carried out by the author under identically similar conditions).

The tests on the gas lamps mentioned previously are compared with tests on the electric lamps as shown above. In the total candle-power, these figures are very striking; 1,964 gas lamps gave a total of 109,000 c.p., and 1,964 electric lamps gave a total of 146,000 c.p. at 20°, 193,883 at 10°.

The illumination was increased directly in proportion to the increased candle-power, as the position, height, &c., of the lamps remained the same.

It is interesting to note from my paper read before this Institution at Manchester in 1905 that the figures given as an average minimum *direct* illumination taken from a large number of important towns came out as follows :—

	Average in 1905.	Marylebone, 1909.
Main thoroughfares ...	0·050 cb. ft.	0·15
Side streets	0·025 ,,	0·048 to 0·07
Suburban streets	0·005 ,,	—

In the important thoroughfares there are an average of 76 posts to the mile, and in the less important streets 65 posts to the mile, so from the above it will be seen that at 1·42d. per unit the cost per annum works out at :—

Main thoroughfares	£384 per mile.
Side streets	204 ,,

At 1d. per unit, the cost would be: Main thoroughfares, £356 per mile; side streets, £190 per mile.

At the time when Oxford Street was changed from gas to electric lamps, the most efficient lamp available for the purpose was the converging carbon flame arc lamp, which was used, the globes being of the opalescent type. Two such lamps were erected on centre poles at distances of nearly 200 ft.; this resulted in a minimum horizontal illumination of 0·11 c. ft. The cost of this type of lamp works out at nearly £20 per annum, or £800 per mile per annum.

Since that time the arc lamp makers have turned their attention to altering the distribution of light from flame lamps in order to make them more suitable for street lighting.

It is difficult to arrange for the arcs to be higher than 25 ft. from the ground, and the distance between them is rarely less than 150 ft., and is sometimes as much as 300 ft.; therefore the light rays which reach the point of minimum illumination are those emitted at 10° to 17° from the horizontal. Some tests which I have lately conducted in Oxford Street, Oxford Circus and Regent Street proved these rays to be of the following candle-power (see Curve II) :—

10-ampere Union flame arc lamp, opalescent globe, 10° to 15°	1,100–1,200 c.p.
10-ampere Union flame arc lamp, dioptric and opalescent globe, 10° to 15°	1,750–1,800 ,,
12-ampere Union flame arc lamp, dioptric and clear globe, 10° to 15°	3,700–4,400 ,,

This already indicates the advance Messrs. Koerting & Matheson have made in the right direction by the introduction of the dioptric globe; for example, if these dioptric globes are used, the illumination is increased 60 per cent. without appreciably increasing the cost of maintenance. If a clear outer globe is used, the illumination is more than doubled. Messrs. Crompton, with the Crompton-Blondel lamp, and the Jandus Arc Lamp Co., with their regenerative flame arc, have both made a great advance in this direction, as has been already demonstrated by the valuable tests carried out by Mr. J. T. Morris at the East London College. Table I is compiled from Mr. Morris's figures and further tests taken by myself.

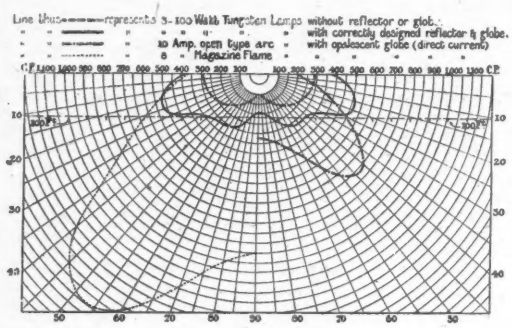
The above figures refer to tests made on the lamps when using the carbons recommended by the makers; they can only be taken as a rough guide, on account of the question of globes, and also the current at which the lamps are run, low-current arc lamps being always much lower in candle-power output per watt than those taking more current, and this particularly applies to flame lamps. The vertical carbon lamps, though of much higher efficiency, are not so steady burning as the inclined carbon lamps on account of the movement of the arc. I have found in the street when photometering that this variation is sometimes 50 per cent. As regards globes, the absorption of these differs enormously, and the greatest care should be taken in their selection, the only method being by testing the lamps and globes under actual working conditions (see Curve III).

TABLE I.—Candle-power per Watt of Various Lamps at 10° to 15° from Horizontal.

Type of lamp.	Watts per lamp.	c.p. per watt.	Type of globe.
Tungsten ...	From 40 upwards	0·8	Clear glass
Grouped tungsten lamps	300	1·5	In specially designed fittings
Open arc ...	500	0·7	Standard opalescent
Enclosed arc, direct current	460	0·5	Clear inner and outer globe
Excello flame arc	460	2·4	Standard opalescent
Excello flame arc	460	3·7	Dioptric and opalescent
Excello flame arc	550	6·5	Dioptric and clear
Jandus Regenerative	360 to 460	5 to 8	Standard globes
Magazine lamp	350	2·0	Standard globes
Magazine alternating	440	1·6	Standard globes

From tests on high-pressure gas lamps, Mr. J. T. Morris draws the conclusion that the candle-power of a high-pressure gas lamp varies 50 per cent., depending on the quality and pressure of the gas. His figures show that from 30 to 34 c.p. per cb. ft. of gas consumed per hour is a very average result when working at a pressure of 4 in. of mercury. My own tests tend to corroborate this. A nominal 1500-c.p. Keith lamp, which gave on test between 720 and 780 c.p. with a consumption of 23 cb. ft. per hour, when compared with a flame arc lamp giving 5 c.p. per watt at 1d. per unit, would have to be supplied with gas at 7d. per 1,000 cb. ft. in order to produce the same light for an equal cost, and thus it is obvious that even high-pressure gas lamps do not compare favourably in cost with those high candle-power electric arc lamps, which embody the improvements of the last few years.

With the exception of very important streets, the tungsten lamp will give a better result at lower cost than the ordinary open-type arc lamps; but it would be unwise to incur fresh capital charges by replacing existing arc lamps with a large number of small posts



Curve IV.—Tungsten Lamps compared with Arc Lamps.

and fittings. At Croydon the borough engineer decided to try the experiment of using groups of tungsten lamps contained in one lantern fixed as high as possible from the ground. It was found that a group of three 100-watt Osram lamps contained in a suitable lantern mentioned in Table I, and of which the profile curve of lighting (IV) is given, when erected 20 to 23 ft. above the ground, gave a much better minimum and much more even illumination than the arc lamps, with the result that nearly 10 miles of road have already been converted to this system of lighting. These lanterns embody the same principles as the Marylebone fitting—namely, to have a large area of white reflecting surface in very close proximity to the incandescent metal of the lamp, with the object of making the source of light appear large, so as not to strain the eye in any way. This white surface is designed to act as an efficient reflector, and does considerably improve the distribution of light by nearly doubling the candle-power at 10° to 20° from the horizontal, as will be seen from Curve IV, which compares the distribution from tungsten lamps fitted in these lanterns with that of an open-type arc lamp. The illuminating results are as follows, these lamps being 73 yards apart and from 20 to 23 ft. high:—The minimum direct illumination is 0·041 when using the tungsten group lantern, against 0·024 when using the 10-ampere open-type arc lamp. The cost per mile works out at approximately £200 per annum; thus a minimum illumination double that of arc lamps is obtained, and at slightly over half the cost. It is interesting to note that when these roads were lighted by gas mantles the minimum direct illumination was 0·0036, and thus the illumination is now about seven times as high, the cost being about three times greater.

The author has devised a combined lantern and cut-out which permits of a series of arc lamps being replaced by a group of tungsten lamps, of which one is a spare lamp placed in a conspicuous position in the globe, and comes into operation in the event of any of the other lamps failing. The lamps nominally in circuit are placed in a circle and are connected in parallel through the winding of an electromagnet to the series mains. The spare lamp is connected through a contact operated by the electromagnet to the series mains. The electromagnet is so wound that when the normal lamps are lighted, and the current is passing through the coils in series with them, the magnet is not excited; but in the event of a lamp failing, the balance of the ampere-turns is upset, and thus the magnet attracts its armature and connects the spare lamp.

At Harrogate the engineer, Mr. Wilkinson, has replaced each arc lamp by four 100-c.p. tungsten lamps, arranged on spreading arms at a considerable height, the result being excellent as regards both illumination and appearance. The lamps are used without globes, but are provided with prismatic reflectors. It is important that the reflectors should be designed with the object of reducing the effect of "glare"; in other words, counteracting the high intrinsic brilliancy of the light source. With arc lamps opalescent globes are very generally used to get over the effect of glare, but the greatest care is necessary in selecting these, as the loss of light is very often a serious matter. This is clearly demonstrated by Curve III, plotted from tests taken by the author under normal working conditions in the open, and it is interesting to note that the opalescent globe B did not seriously reduce the candle-power of the lamp at the important angles, namely, 10° to 15°, whereas C reduced it considerably.

Some very interesting work has lately been carried out in the City of Westminster in connection with street lighting by gas, and as the lighting of Victoria Street has been completed, the writer has had an opportunity of measuring the illumination and judging the effect of what may be taken as the most modern form of gas lighting.

The units of light according to the specification were to be 90 c.p., 180 c.p.; 300 c.p., 1,800 c.p., 3,000 c.p., for which the accepted gas company's tender works out at £2 16s. 6d., £4 10s., £6 10s., £15 10s., and £22 per annum respectively. Of these the 1,800-c.p. unit fixed 20 ft. high was selected for Victoria Street. This street is approximately 3,600 ft. long, and 25 such units have been erected in place of 50 upright double incandescent gas mantles placed 12 ft. from the ground, with the result that the minimum illumination has been increased to 0·15 c.p.

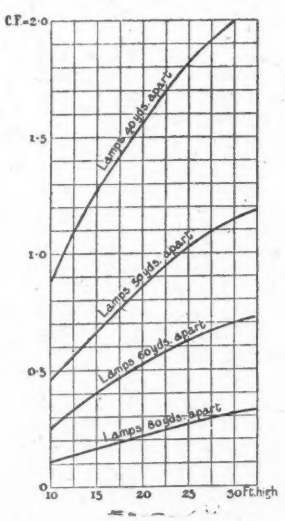
Treating the street lamps as an ordinary consumer, a remunerative price per unit may be taken as 1d. for large undertakings and 1·5d. for small undertakings, which includes, as in the case of consumers, the cost of service to the ordinary distributors, but not of fittings, &c., which would come under the same heading as the consumers' wiring and fittings, which are part of the installation. Even with this rate of charge the revenue per 60-watt lamp is nearly eight times the average revenue derived from lamps installed on consumers' premises, and, moreover, all meter-reading charges are dispensed with and the clerical and office charges are practically nil.

The cost of lamp maintenances must be divided between two different classes of lamps, namely, incandescent and arc lamps; and it is essential to know the cost per candle-power per annum. With tungsten lamps the cost of lamp renewals depends largely on the candle-power and slightly upon the volts; the following figures based on experience in various towns will act as a guide to the likely maximum, including rates of renewing:—

TABLE II.—Cost of Tungsten Lamp Renewals, Lighting, Extinguishing, &c.

Total candle-power of unit.	Cost per annum (4,000 hours).	Cost per candle-power per annum.		
		Naked lamp, renewals.	In special lantern, renewals.	Lighting, extinguishing, &c. (without reflectors).
	s.	d.	d.	d.
50	8	2·4	1·3	4·00
100	13	1·8	1·2	2·00
200	20	1·2	1·0	1·00
300	30	1·2	1·0	0·66
400	40	1·2	0·8	0·50
500	50	1·2	0·6	0·40

The cost of lighting, extinguishing, cleaning and repairs depends largely on the system of supply. The interest and sinking fund on special street-lighting mains is about equal to the cost of individual switching, and therefore the latter system is likely to be



Curve V.—Variation in Horizontal Illumination with Height of Lamp.

largely adopted, in which case the cost per post may be taken as 16s. per annum, this being constant whatever the candle-power of the lamp. The total cost per candle-power works out as shown in Table II.

The capital charges of electric street lamps, of course, depend upon the value of the posts and lanterns; the cost of the service, &c., being put roughly, they may be taken as follows:—

Light units up to 200 c.p. (tungsten) erected 12 ft. high ... £3
Light units up to 500 c.p. (tungsten) erected 16 ft. high ... 5
Light units above 500 c.p. (arc lamps) erected 20 ft. high ... 20

The cost of maintaining arc lamps, including carbons, trimming, repairs, lighting, and extinguishing, varies very much with the

type of lamp, the enclosed or regenerative type of lamp naturally being the lowest, and flame arc lamps burning a good quality of carbon being the highest. In the following estimate it is taken that one man can attend to 130 enclosed or regenerative-type lamps and 70 open-type lamps; the cost per annum works out approximately as shown in Table III.

TABLE III.—Cost of Arc Lamp Carbons, Trimming, &c.

Size of light unit.	Cost per annum.	Cost per c.p. per annum.
300 c.p. unit (open type)	£4 10 0	3·6d.
1,000 c.p. unit (flame arc dioptric globe and opalescent outer)	£8 0 0	2·0d.
3,000 c.p. unit (flame clear outer) ...	£8 0 0	0·7d.
2,000 to 4,000 c.p. unit (regenerative flame)	£2 10 0	0·3d. to 0·15d.

These results will, of course, vary with the local circumstances, cost of labour, &c., but can be taken as a very general guide. Adding together the previous figures, we get the total cost per candle-power per annum exclusive of capital charges, this table including cost of current taken at 1d. per unit.

TABLE IV.—Total Cost per Candle-Power per Annum.

—	Candle-power of light unit.	Cost per candle-power per annum.	
		Naked lamp.	In special lantern.
		d.	d.
A	50 tungsten	10·50	7·0
A	100 tungsten	8·20	5·0
A	200 tungsten	7·00	4·3
A	300 tungsten	6·66	4·1
A	400 tungsten	6·50	3·8
A	500 tungsten	6·40	3·5
B	300 open arc	10·20	—
C	1,000 flame arc	3·65	—
C	3,000 flame arc (dioptric and clear outer)	1·32	—
D	2,000 to 4,000 regenerative flame ...	1·0 to 0·8	—

Having obtained an approximate table of costs per candle-power per annum for various units of light, it is easy to ascertain which are the best to use under different circumstances. For this reason I have given in Table V the total candle-power necessary to produce a minimum of illumination (horizontal) of 0·1 c. ft. with lamps spaced at two different distances and also at different heights—namely, 20 and 12 ft.

It will be noticed that when the lamps are spaced at 30 yds. apart, only one-ninth of the total candle-power is necessary to give the same result as when they are placed 100 yds. apart; therefore from the table of costs per candle-power it will be seen that unless a lamp giving a very high candle-power at low cost be used, the closer spacing would be the cheaper alternative. Again, converging flame lamps (unless provided with dioptric globes) when erected at 70 yards give illumination at the same cost, equal to small units of light placed between 40 and 50 yards apart, provided, of course, the small units of light are fixed at the same height.

In order to obtain even horizontal illumination, the lamps should be placed as high as possible; but increase in the height

TABLE V.—Candle-power necessary to obtain Minimum Illumination 0·1 c. ft.

Space between lamps. Yards.	Candle-power of lamps.		Total candle-power per mile.	
	12 ft. high.	20 ft. high.	12 ft. high.	20 ft. high.
100	—	8,800	—	156,000
90	—	6,300	—	125,000
80	7,300	4,539	160,000	100,000
70	4,800	3,060	121,000	76,600
60	3,140	1,950	92,000	57,000
50	1,820	1,186	63,500	41,600
40	950	620	41,500	27,300
30	400	300	23,300	17,600

would not increase the illumination of pedestrians and vehicles or other vertical objects, and it is certainly misleading, owing to the introduction of the cosine factor. Maximum illumination with the inclined carbon flame lamps is a high as 10 c. ft. in Oxford Street, with a minimum of 0·11 c. ft., or a diversity factor of 90. In Baker Street the maximum illumination on the ground is 0·5 c. ft. with a minimum of 0·08, a diversity factor of only 6. Again, in Regent Street, where Excello lamps having dioptric globes are in use, the maximum illumination does not exceed 3 c. ft., the minimum being 0·23 c. ft., or a diversity factor of 13.

The importance of correct characteristic light distribution is clearly brought out by comparing the candle-power, at various downward angles, necessary to produce even illumination, with the candle-power given at those angles by a tungsten lamp with a suitable reflector, such as the Marylebone type, which fairly closely approaches the correct curve; a vertical low-pressure gas mantle, which gives about the same curve as a tungsten lamp without a reflector; and a low-pressure inverted gas mantle.

The effect of using correctly distributed light is not only more even illumination, but also reduced cost of lighting for a given minimum, which is seen by the following comparisons:—

Position.	Minimum illumination.	Diversity factor.	Cost per mile per annum.
Baker Street (electric) ...	0·08	6	£356
Regent Street (electric) ...	0·23	13	660
Victoria Street (high-pressure gas)	0·15	20	540

Note.—The tender for the Regent Street type of lighting was subsequently reduced to £425 per mile per annum.

The importance of the diversity factor cannot be over-rated. It is the possibility of using specially designed globes and reflectors with electric lamps which gives them a great advantage over gas, where the dissipation of the great heat necessary for the efficient use of mantles makes the use of efficient globes and reflectors a practical impossibility.

It is noticeable that in the past the small-light units derived from gas have been more economical for outdoor lighting than those produced by electricity. The reverse is now the case, therefore electrical engineers should be able to compete favourably, considering that the light they are able to supply is constant, reliable, capable of correct distribution, and easily manipulated, which must result in its adoption for exterior lighting in the same way as it has been so generally adopted for interior lighting.

In calculating the cost per candle-power the writer has in most cases given the figures as based on the horizontal candle-power of the naked tungsten lamp; whereas, where they have been erected in suitable lanterns or globes, this cost per candle-power is reduced to a half or a third. This must be carefully borne in mind when using the tables referred to.

Discussion in London.

Mr. Frank Bailey, who opened the discussion, said street lighting ought to be considered from the point of view of how much light there ought to be, rather than how much could be got at the least cost. Present day traffic conditions demanded far better lighting than was given, and some authority should be engaged to settle a specification which would meet modern conditions. In the City of London his company had had to beg of the authorities to be allowed to show what they could do in improved lighting; he deprecated this attitude, as it was a matter of life and death that sufficient illumination should be given in roads and streets. Cheapside was an example of main street lighting at moderate cost; he did not think metal-filament lamps were suitable for this class of lighting.

Mr. C. P. Sparks urged that the Institution E.E. would be doing a service if it would draw up a fair specification on broad lines for street lighting. He supported the author's view as to the importance of a low diversity factor. It was the duty of the authorities to modernise their arc lighting, as it compared badly with modern gas lighting, and especially so with modern arc lighting. The price of 1d. per unit mentioned appeared to be on the high side for large cities; a lower price was necessary to get business.

Mr. A. H. Seabrook said if one considered the actual figures for gas lighting obtained by the author for his own satisfaction, there was a surprising divergence from the generally accepted figures. The price of 1d. per unit mentioned, seemed justified in a commercial sense, as it was an acceptable figure. It was an illogical attitude to refuse loans for street lighting, with a 10-year period, but to sanction them for a consumer's service, although he might be away for six months in the year. With open type arc lamps, £880 per mile seemed a high figure—the Oxford Street lighting, which was understood to be an extravagant example, only cost £800 per mile. He considered that the tungsten lamp might efficiently be used where circumstances prevented the use of the arc lamp.

Mr. W. A. Vignoles referred to a recent sanction by the L.G.B. of a 10-year loan at Grimsby for street lamps, fittings, &c., which he considered showed that such schemes, if worked out in detail, were not absolutely vetoed by that body. He questioned whether the minimum horizontal candle-power taken by the author was the right thing, as the rays striking a vertical surface seemed to give a better standard of illumination. It was quite possible to have a good minimum illumination all over a street, but yet the effect would scarcely be so good as by using arc lamps with the same minimum illumination but a far higher maximum. In Grimsby, enclosed flame arcs had been substituted for the old ones, giving four or five times the light at less cost. This lighting cost £400 per mile, the lamps being 84 yards apart. He questioned the fairness of comparing the old type arc with the tungsten lamp, as the latter was designed to give the nearly horizontal illumination, which the author wanted. Possibly a dioptric globe on an open-type arc would shift the maximum lighting to a position approaching the horizontal. In Grimsby new posts with fuse boxes in the bases had been adopted for the tungsten street lighting; it was undesirable

to have the fuses at the top, as was generally the case where old posts were used. Two lamps were much more effective than one, owing to the reflection of glass surfaces, and a price of 1d. per unit for energy was satisfactory in Grimsby.

Mr. A. P. Trotter said the diversity factor in street lighting was an important matter, and he rather agreed with the views of the previous speaker on this. Some 30 years ago he had invented the Trotter dioptric globe, which was the forerunner of present-day patterns; he tried to distribute the light uniformly, but he thought people did not want it—they wanted changes in lighting. This meant a moderate diversity factor and a good minimum. The lighting of small streets called for more skill than that of wide ones.

Mr. Leon Gaster suggested that, in view of present-day traffic conditions, motor-car taxation could be appropriately used for improving street lighting. In Germany a committee had been appointed to fix standard specifications for both outdoor and indoor illumination.

Mr. W. R. Cooper thought the author's definition of candle-power required amplifying; candle-power might be stated in terms of distance. The introduction of a second diversity factor was liable to lead to confusion.

Mr. C. M. Shaw said £3 15s. per post, as charged at Marylebone, was on the high side for provincial towns. In Worcester they were replacing open type arc lamps as fast as possible, and were suspending the new lamps from cross wires attached to the tramway poles, some 16 ft. above the ground. This lighting cost £117 per mile.

Prof. Morris, on the question of glare, said it was an open question whether the source of light should be visible in the street—the ratepayers would say "Yes," as it gave a decorative effect. He suggested screening the lamps to 10° or 15° below the horizontal in main streets. Some experiments which he had carried out to test the effect of light on the eye, with (*a*) a naked lamp; (*b*) a lamp with a mirror behind it; and (*c*) a lamp with a sheet of white paper behind, showed that the area of the pupil of the eye, taking case (*a*) as 100 per cent. was for (*b*) 85 per cent., and for (*c*) 110 per cent., showing the advantage of the white reflector, which was the most restful to look at.

Mr. K. Edgcumbe agreed as to the utility of a standard specification of street lighting, but thought it would be politic to carry out the idea jointly with the gas interests and surveyors.

Mr. Horace Boot suggested that narrow side streets could be lighted best by lamps suspended midway. It had always seemed to him that the price put down for energy for street lighting was on the high side; in small towns it probably did not cost more than ½d. per unit. In the case of a supply authority in a provincial town, whom he had been advising, they had obtained a contract for all the public lighting and laid mains for this at considerable cost, but this was justified as private consumers were being obtained all along the routes, which more than covered the expenditure.

Mr. Dow said mere lamps on posts did not give illumination; other lighting was needed on the buildings. He considered that more attention should be given to surface illumination and not so much to the source of light.

Mr. Haydn Harrison, in replying, said unfortunately the price of lighting was beyond our control, and the necessary increased illumination could not be given. He was not altogether in favour of centre lighting in main streets; drivers of vehicles experienced the glare of the lamps and the light was shielded from the pavement. The question of a standard specification presented difficulties in view of the various interests concerned, and possibly an independent society—one in which the surveyors had an interest—would preferably undertake the work. He thought 1d. per unit for energy was rather a high figure for street lighting purposes, but Electricity Committees did not appreciate the problem. He did not agree with Mr. Vignoles's views of diversity factor, as he considered that after being in a brilliantly-illuminated area, people could not see in the less lighted places, they lost their seeing capacity. The lighting problem really lay in the small streets, all attention had so far been given to the shopping streets. In reply to Mr. Cooper, the paper dealt with mean horizontal candle-power as was stated. He reminded Mr. Shaw that at Worcester only 44 poles per mile were dealt with, while in Marylebone at least 65 posts per mile were used.

The Irregularities in the Rotating Field of the Polyphase Induction Motor.

By Charles F. Smith, M.Sc., M.I.E.E.

Discussion on paper read before the Institution of Electrical Engineers *at Manchester, November 8th*, 1910.

Mr. Cramp said that under the heading of "Grouping of Coils," there was the statement, "On connecting the search coils belonging to one pole together in series, the resulting voltage was found to be equal to the arithmetic sum of the voltages of the individual coils. This was to be expected." It seemed necessary to point out that the above result was not to be expected except on the assumption of fairly low tooth-densities. The motor which had been particularly tested had 60 slots in the stator and 48 in the rotor, and it had four poles. That was 15 and 12 slots per pole respectively. These two numbers had a G.C.F. of three. This matter affected the results throughout the paper, though he did not find any reference to this G.C.F. by Mr. Smith. The author, whilst giving reason for variations in voltage, omitted altogether any reference to pulsation produced by eccentricity of the rotor with respect to the shaft. In some cases he had found such lack of truth to be very important. The author said, "The conditions under which the readings of fig. 5 were taken were such as to make the voltage of coil *c* a maximum, that is to say, the conductors of this coil must have been situated at points of maximum flux." When the voltage of coil *c* was a maximum, the rate of change of flux through it was a maximum, but it did not follow that the flux itself was a maximum. With regard to the effect of flux pulsation on coil voltages, a component of the pulsating voltage might be due to the number of times per second there was a correspondence between the rotor and the stator teeth. It did not follow that this change would correspond with the flux moved per tooth. The effect to which he referred was dependent on the G.C.F. between the stator slots per pole and the rotor slots per pole. The effect of uneven air-gap was mentioned, but even if the air-gap was uneven as described, the effect would be smaller than Mr. Smith thought, especially with a small number of poles, for the path of the flux involved crossing the gap twice, so that in a two-pole case the increase in field strength, due to uneven air-gap, should be practically zero. His conclusion was that pulsation voltages were of importance only in very high-pressure machines, and the average induction motor, as at present constructed, was, on the whole, wonderfully free from effects due to irregularities in its field.

Prof. E. W. Marchant said, as to the effect which the load on the motor had of increasing the losses due to pulsations in the teeth of the induction motor, Mr. Lawson, a former student of his, had made a good many experiments on this, and found that the increase in those pulsation losses was very considerable, the magnetic pulsations in the teeth being more than doubled in certain cases under full load. Mr. Smith gave the figures for the voltage induced in the rotor or on open circuit and the corresponding current. The frequency of the voltage induced in the rotor would be very high, since it was due mainly to field irregularities due to the teeth, and therefore it was not at all surprising that the current which flowed in this particular case was small, on account of the large impedance of the rotor to those currents. Referring to the effect of an uneven air-gap, the author mentioned four effects. The first was really negligible, because the magnetic drag produced with an eccentric rotor depended simply on the hysteresis and eddy current losses in the rotor. In (3), the additional losses gave lower efficiency and a diminished torque. Referring to No. 2, "the concentration of the applied voltage in certain coils of the winding produced unequal dielectric stresses"—the unequal stresses that occurred in an induction motor when switched on were very large compared with any inequalities that could possibly be got due to unequal distribution of the field. The unequal voltages in the phases of the rotor resulting in an unsymmetrical distribution of currents, varying with the frequency of rotation, were one of the most important effects of an uneven air gap. It should be noticed that the effect due to eccentricity was only important if it produced unequal loading of the phases of the stator. If the currents in the three phases were different, unequal bands of rotor current were produced, which had the effect of causing useless circulating currents in the rotor conductors, and these produced excessive heating of the rotor. This was emphasised by the illustration quoted by Mr. Smith at the end of his paper.

Mr. G. W. Worrall said he found a very interesting confirmation of some work he published in 1908. The machine employed was a synchronous generator with rotating armature. By varying the width of the pole face, he found that the magnetic pulsations, as shown by a search coil wound round the pole shoe, were a maximum when the polar arc was an exact multiple of the tooth pitch, and a minimum when it was a whole number plus one-half. The electrical and magnetic conditions obtaining in such a machine appeared to be similar to those obtained in the induction motor as arranged for the experiments described by the author, for when the rotor rotated at synchronous speed, the field produced by a three-phase current in the rotor windings was approximately stationary in space and constant in magnitude. The stator teeth would, therefore, cause no pulsation except as a function of any cyclic irregularity which might exist in the main flux. Since this latter was in any case very small, the influence of the stator teeth might be considered as a negligible quantity. The rotor teeth, however, were passing through the main field, and would therefore set up pulsations. These pulsations would induce E.M.Fs. in a coil on the stator in exactly the same way as in the case of the pole-shoe coil in his own experiments, and should therefore be subject to the same law as regarded the span of the coil. That this was the case, might be readily seen from the paper and the oscillograms given in figs. 5 to 9. Here coils *a*, *c* and *e* spanned 18·2, 12 and 8·8 rotor teeth respectively, all of which numbers were nearly whole numbers, while coils *b* and *d* spanned 13·6 and 10·4 respectively, which might be written approximately as whole numbers plus one-half. In the former case the magnitudes of the oscillations were much greater than in the latter case, both in the oscillograms and in the actual voltmeter measurements given in fig. 4. The influence of the stator teeth was of far greater importance when the motor ran under normal conditions, for then the stator teeth were subject to the rotation of the main field at synchronous speed, and therefore produced pulsations in it in the same way as the rotor teeth did in the author's experiments. Under these conditions, however, the rotor teeth had far less importance, for they were only subject to the main flux rotating at the speed of slip, hence the pulsations produced by them would be relatively small. Such conclusions assumed that the two sets of teeth behaved independently of each other, and his own observations of the behaviour of the magnetic flux between two surfaces separated by an air space, led him to believe that the two sets of teeth behaved to a great extent in a manner independent of each other.

Dr. E. Rosenberg was in agreement with the author that the air-gaps of induction motors should not be too small. Mechanical reliability was a most important feature of a motor, and it was not right to sacrifice it in order to improve the electrical performance. A good power factor was wanted, but the air-gap must not be reduced below safe limits. He was of the opinion that in electrical machinery, by far the greatest number of breakdowns were due to mechanical reasons. Mr. Cramp had suggested that the addition of currents of different frequencies would only be correct if the passing harmonics were sinusoidal waves, but this was not so. The resultant value of waves of different frequencies could always be taken as the R.M.S. whether each of the components was a simple harmonic or was itself the R.M.S. value of several components of different frequency. If one of the components was not a sinusoidal wave, this indicated that the measured value of the component was itself a resultant of sinusoidal waves of different frequencies, and it did not matter whether the R.M.S. of all the different components were taken at once or taken in different steps, it always remained the same.

Mr. J. Frith, speaking on the effect of uneven air gap, said that if this was really going to be troublesome, the coils could be connected in parallel on the opposite side of the motor, and not in series; and instead of having the magnetising current the same and the flux varying inversely with the clearance, put the same voltage across the coils, and then the flux was bound to be the same whether the rotor was central or not.

Mr. F. C. Aldous said it was a well-known fact that if the rotor of an induction motor was out of centre, and if all the coils were connected in series, there was a higher flux on one side of the rotor than on the other, causing an unbalanced magnetic pull, but any extra losses that were set up could not be considered as important or as affecting the output of the motor. They could only be confined to the stator teeth, and were easily got rid of. The scheme of connecting the windings in two or more circuits, as suggested by the last speaker, was often done. It was not practicable in many cases, particularly in high-tension motors.

Mr. C. F. Smith, in his reply, said with regard to the magnitude of the pulsation effects in the Siemens motor compared with those in the Phœnix motor, as commented upon by Mr. Cramp, the pulsations were not very greatly less in this motor than in the first one for which the results were recorded. No doubt the G.C.F of the number of slots on stator and rotor would affect the flux variation, but not quite so much as Mr. Cramp thought. Nor was this the pulsation which was recorded on the curves given in the paper. Mr. Worrall's remarks comparing the effects described in the paper with oscillations which he had measured on the synchronous generator were exceedingly interesting. Dr. Rosenberg's contention that a very small out-of-balance current in the rotor would be sufficient to equalise the flux round the stator was, of course, a very important point. The question of the magnitude of this current seemed not to be known with any certainty. The out-of-balance of the field might be expected to act in two ways—in producing these unequal currents in the rotor and also in producing unequal losses in the teeth. The actual amount of copper losses had never been properly investigated. Mr. Frith's suggestion that the coils should be connected in parallel, in order to maintain equal pole fluxes, was a very ingenious one, and would undoubtedly produce the effect desired. Replying to Mr. Aldous, losses that might be expected from inequality of the field were not confined to the stator teeth, as suggested, but would be found in both the rotor and stator teeth, and also in copper losses, due to equalising currents set up in the rotor winding.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Electric Rotary Drill.

The Montania Engineering Co., Ltd., of 11, Queen Victoria Street, E.C., have introduced an improved electric rotary drill, for drilling soft and moderately hard rocks when driving galleries, &c. The drill, as illustrated herewith, is driven by a three-phase induction motor of 1·4 H.P. at 110 or 220 volts and 50 cycles, and is damp and dust-proof; a set of differential gears is enclosed in the box on which the motor is mounted, and the feed can be varied from 2 in. to 2 ft. 3½ in. or more per min., to suit the hardness of the rock. A safety friction coupling is provided in the feed-gear to protect the machine in case the drill should meet with a hard spot when drilling non-homogeneous rocks, such as rock salt or coal permeated with slate. By throwing a lever, the drill is withdrawn at the rate of 6 or 8 ft. a minute, avoiding loss of time. Limits are provided to the automatic travel of the screw, and the latter has been considerably strengthened; the main gear shaft runs in ball bearings, preventing wear and keeping the distance between the axes of the gear wheels constant. A new type of plug contact has been evolved to suit the severe conditions of mining work, with few but strong parts, arranged so as to prevent short-circuiting. The outfit is carried on a strong telescopic double column, with the necessary accessories, including a cable drum with 60 yards of cable.

The company also make an electric plunger rock drill for hard rocks, driven by a similar three-phase motor.

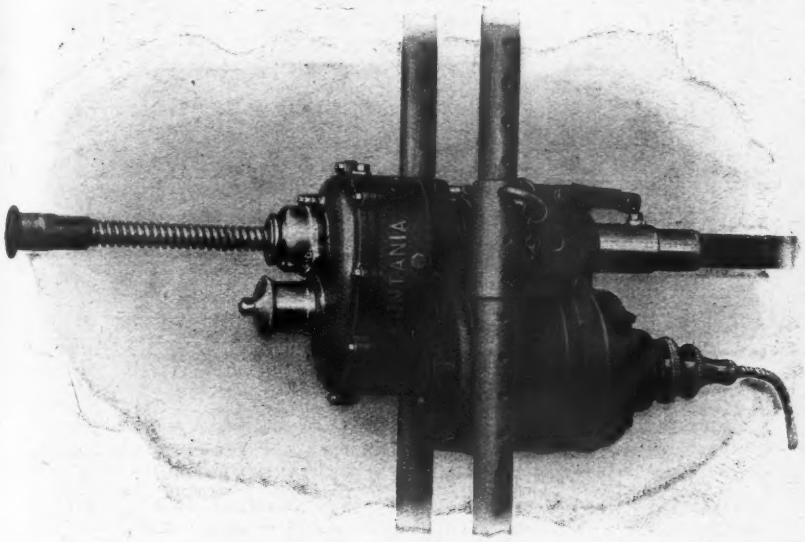


Fig. 1.—Electric Rotary Drill

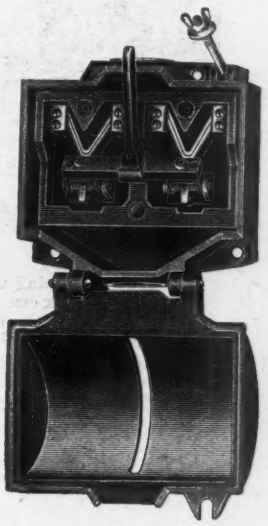


Fig. 2.—Ironclad Switch, swowing Interior (p. 898)

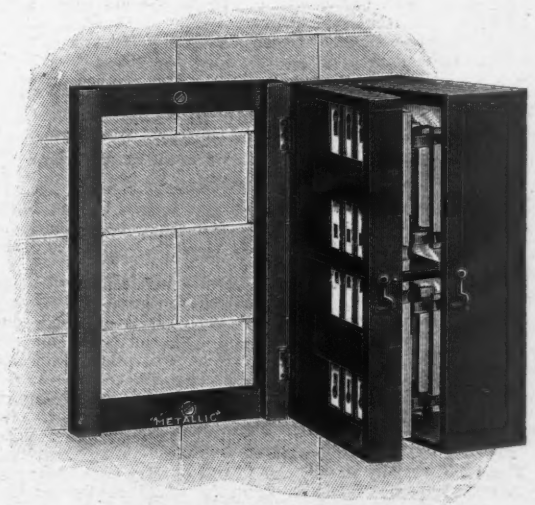


Fig. 3.—Fuseboard with Swingback (p. 898).

Fuseboards, Switches and Lampholders.

The Metallic Seamless Tube Co., Ltd., of Wiggin Street, Birmingham, have sent us some particulars of recent productions at their works.

Fuseboards with Swingbacks.—One of these is illustrated in fig. 3. The portion of the board carrying the porcelain bases is free to swing out, thus facilitating the initial wiring and subsequent inspection. The swingback can be fitted to any of the company's standard fuseboards at a small extra cost.

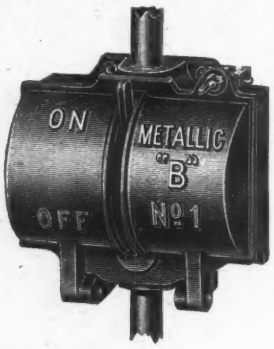


Fig. 4.—Ironclad Switch for Screwed Conduit Work.

Fig. 5.—Insulated Automat Connector.

Ironclad Switches for Screwed Conduit Work.—In order to meet the demand for a switch for use in connection with screwed conduit, the company has placed on the market a design with a screwed outlet at top and bottom, to take any size of screwed conduit. The switch base is of china, and easy wiring is a feature; the whole switch is standardised in sizes from 20 to 200 amperes, and meets the requirements of the Glasgow Corporation. Figs. 2 and 4 show this switch open and closed.

Fig. 6.—Automat Connector.

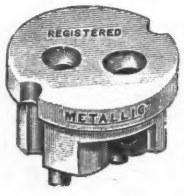


Fig. 7.—New Model Lampholder.

Automat Connectors.—Figs. 5 and 6 show insulated and uninsulated connectors for rapid wiring, without the use of screwdriver or solder. The insulated type is contained in a porcelain case.

Lampholders.—The "New Model" lampholder, illustrated in fig. 7, is fitted with an exceptionally heavy and well-glazed china interior, and the brass parts are secured by a patent method, with which there are only two holes in the china and no live metal whatever at the back. It is claimed to be the best H.V. holder on the market.

Electric Lighting Sets for Country Houses.

Among the exhibitors at the recent Stanley Cycle and Motor Car Exhibition at the Agricultural Hall, London, N., were Messrs. Stuart Turner, Ltd., engineers, Henley-on-Thames, who displayed a number of compact sets of petrol engines and dynamos for the electric lighting of country houses, yachts, &c. The largest size was of 1,000 watts capacity, and comprised a single cylinder (3½ in. bore by 3¾ in. stroke) engine of the vertical two-cycle type, mounted on the same bedplate as, and coupled direct to, a slow-speed shunt-wound dynamo. The motor was provided with magneto ignition and a governor-controlled throttle, while the dynamo could be arranged for any voltage from 35 to 110. To avoid any damage to the armature, a special flexible coupling is introduced on the shaft between the engine and generator. Messrs. Stuart Turner are also building similar sets in smaller capacities—120-watt, 200-watt, 300-watt—for small lighting installations. These are specially suitable for use in country motor garages, for they can be used not only for lighting, but also for the charging of accumulators, which are now largely used in connection with the illumination of motor vehicles.

Motor-Tire Testing.

In order to demonstrate the amount of power which may be lost between the wheel and road through internal friction of the tire, and more particularly to show the advantage in this respect which is claimed for the Palmer cord principle of motor-tire construction, The Palmer Tyre, Ltd., of Shaftesbury Avenue, W.C., have introduced an electrically-driven testing machine, which they had on view at the recent Olympia Exhibition.

This machine, which we illustrate in fig. 8, consists of a frame carrying two spindles run on ball-bearings, one of which, on the right, is chain-driven by an electric motor, and is stationary, while the other is carried on a rocking lever, the other end of which is coupled through a dynamometer to a screw and hand-wheel. The spindles carry wheels on which the tires under test are mounted, one tire driving the other, and the necessary load is obtained by means of the hand-wheel and screw and recorded on the dynamometer.

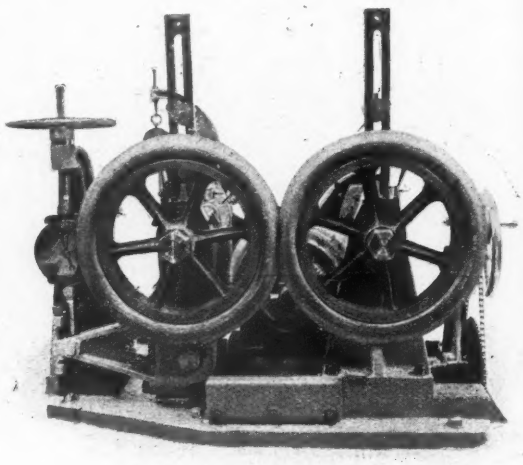


Fig. 8.—Motor-Tire Testing Machine.

The power supplied to the motor is measured electrically, and from this is deducted the power absorbed in the motor, chain-gear bearings, &c., the latter being obtained by running plain steel-rimmed wheels with the same contact pressure as is used for the tires. Corrections are made for C^2R losses in the armature varying with the load, and small errors arising from variables are covered by taking average results.

As previously mentioned, this method of testing was introduced primarily to confirm the economy in power which The Palmer Tyre, Ltd., claim for their cord tires in comparison with canvas-lined tires, the ratio of the power absorbed, when measured in the case of a set of 810 mm. × 90 mm. tires at 24 miles per hour, being in the case mentioned 1 : 1·8 in favour of the former.

LEGAL.

Griffiths and Another *v.* Benn.

(*Continued from page* 856.)

In course of a discussion between Judge and counsel, Mr. Smith said that what the plaintiffs maintained was that their efficient system was installed in an inefficient fashion in the Mile End Road.

Sir Edward Clarke: That was all Sir John Benn was dealing with.

His Lordship: Of course that is a question for the jury.

Subsequently Sir Edward Clarke again protested that Sir John Benn was not referring to Lincoln.

His Lordship: You have taken it upon your shoulders to say it was a total failure.

Sir Edward Clarke: I have said it was a total failure in London.

His Lordship: Everywhere.

Sir Edward Clarke: No, not in Lincoln.

His Lordship: He wishes to establish the value of his system.

Sir Edward Clarke: At my expense.

Mr. William Griffiths said he had spent £15,000 in perfecting the G.B. system. He considered there was no reason why he should not have got the contract for laying down the track but for the spiteful attitude of Mr. Fitzmaurice. He agreed that the patents were now valueless. He estimated the value of the patents at the time the defendant began his attacks at a quarter of a million sterling. The prospects of the business had been full of promise; it was now ruined.

Cross-examined by Sir Edward Clarke, Witness stated that he took part in building the first of the conduit tramways in London. Elsewhere the only place where there was a conduit system was in Bournemouth, and it was coming out directly, owing to the cost of working it.

Mr. W. M. Mordey said he was instructed by the L.C.C. to make a report on the surface-contact tramways. He reported that all the defects were remedial. He put that in the forefront of his report, because it was that question he was specially instructed to answer in the resolution of the London County Council. His subsequent examinations confirmed that opinion, which was based upon what he might describe as laboratory tests. Afterwards when he came

to make running tests, he found he had been unusually cautious in his report. At Lincoln he found many of the defects, which had had to be remedied there, were what might be called tuning up faults, such faults as might be found in the installation of any new system. He found that in London the difficulty was surface leakage. He was told by the L.C.C. officials that they could not run this system at over 10 miles an hour. That was due to the weak nature of the magnets, but when he wrote his first report to the Council he was not aware that this was the cause. When a magnet was put upon the experimental car by the G.B. Co. the speed went up beyond the legal limit without difficulty. The improvement was in the proportion of about five to one. Comparing what took place at Lincoln and in the Mile End Road, he could at first only assume in the circumstances that the earth was a better conductor of electricity in the Mile End Road than at Lincoln. Afterwards he found there was a further cause of leakage, in that the Bow Road had been treated with salt, and brine was a very good conductor indeed. Subsequent knowledge led him to believe that arcs, if they did occur, could be made quite innocuous. The G.B. Co. had offered to come to him, and he had suggested they should write him a statement of the cause of the defects. Through, as they explained, being unable to get particulars from the L.C.C. officials, he did not get the G.B. Co.'s statement until the day he sent off his report. In his first report he suggested modifications of the studs, but with the magnet provided by the G.B. Co., he found the studs were all right as they were. He had suggested increasing the sensitiveness of the studs, but it was better to increase the strength of the magnet. For the experimental half-mile, no material alteration was made in the construction of the studs. He found that the magnet put on the car by the G.B. Co. was much more powerful than the former magnets, and that its magnetism was obtained with a much less consumption of energy. The difficulty about picking up iron scrap was got over by covering the magnetic surfaces with non-conducting material. When he first took up the matter, he felt sure that a horse trotting quickly would cause the movable part of the stud to go down, and, by contact with the cable, make the stud momentarily alive, but he found that by no blow of horses' hoofs or blow that would take place in traffic—even by a traction engine going over an obstruction and falling on the stud—could a stud be made alive. Mr. Fell persisted in the former view up to the end, although it had been demonstrated that the conditions of traffic would not cause this effect.

In answer to a question by his Lordship, Mr. Mordey stated that he investigated this matter very fully. He had a test made of all the 5,000 studs on the track six or seven weeks after the service was stopped. Only five studs were in contact with the cable, and they were taken up and examined. Three had fallen through insulating pins breaking, and the two others were in contact because of dirt getting in. Much had been made of the breaking of the earthenware T-pieces of the conduit, but he found only two of them had let in dirt. One thought how small a breakage this was in these seven weeks' of neglect and idleness. If the service had been running, studs of this kind would have been detected and put right. In all tramway systems there were very heavy charges for repairs and upkeep of parts. Ventilation of the conduit was necessary to prevent the accumulation of gas, which was objectionable not only because it caused explosions, but because it acted upon the metal underground.

Mr. Mordey, continuing his evidence, said the officials of the L.C.C. gave him every help, but he thought they were a little disappointed when they found the results coming out so favourably. He at first thought that the conditions in the Mile End Road would require more careful treatment than at Lincoln, but he found afterwards that he had been too cautious. He would expect a tramway which ran in a busy road in one town to run in another. He found he was working under artificially-produced conditions in the Mile End Road. Salt put down on the road made any water a conductor of electricity and encouraged leakage of current. Mr. Bedell gave him certain assurances, but otherwise witness had nothing to do with the design of the two magnets, which were provided for the tests and experimental half-mile. The magnets he originally found on the cars were about 3 in. apart. Those Mr. Bedell supplied were about 3 ft. apart. The advantage was shown by the result, as the working was much better. He had the means of comparing the two generally, and with the new magnets the studs gave a prompt response. The weather when the first trial took place on the experimental ½ mile was very bad. The conditions were, in fact, so trying that he suggested to Mr. Bedell that it would not be unreasonable if the trial was postponed. As many people interested in the trial were present, Mr. Bedell went on with it. Referring to the salt on the road, he said he, at first, thought it was a very curious case of local snowfall. For the first trial, said witness emphatically, "we had the worst possible condition for leakage. I think one might have expected almost any system to have failed to work at all under such conditions." Describing the details of the trial, witness stated that at the very first trial after the G.B. Co. had overhauled the track and car, a speed two and a half times as great as formerly, was attained with very much less energy. Finally, they were able to run with one magnet instead of two. The conditions under which the witness conducted experiments, varied from an icy condition of the road with salt, to a perfectly dry road. In all these conditions the results were satisfactory, and the arc-stopping device was effective. It had been impressed upon him from the beginning, the Witness said, that the live studs were the important trouble, and that if the trouble was got over, the others were only matters of mechanical adjustment. The cross-overs could have been put right without difficulty. The conduit system had its class of faults, and there was no perfect system. He estimated the cost of putting the track into order at £6,300 and the cost of 12 car equipments at £1,980. The track charges would not be for alterations in the system, but only for putting it right. He made no alteration in the system, but he made a small addition to it to meet new conditions. It was an efficient system, and could not be properly described as mischievous and impossible; in the ordinary sense of the word it could not even be considered a risky system. To say that the leakage would run up the cost of current by 20 per cent. was not true. He found the leakage was usually greater on the conduit system than on the G.B. system. The leakage from the stud heads worked out at about one-hundreth of a penny per car-mile. It was not realised, Witness explained, that the leakage in the damp, and sometimes dirty, conduits of the conduit system was very heavy. The total current used on the G.B. system was much less than on the conduit system.

Cross-examined by Sir Edward Clarke, Witness admitted that live studs were a serious matter. The conditions in London were not the most severe that could be imagined. He recently reported to the Corporation of Torquay on the surface contact system which had been installed there, and he found it was working fairly well considering the way in which it was being treated.

To the suggestion that the Board of Trade had refused to consent to an installation of the G.B. system in that town, Witness replied that he understood that the Board of Trade refused to licence two systems in one place.

Regarding the salting of the Mile End Road, Witness stated that as he knew of salt being put on the road in mild weather; salt might have been put down by the officials during the public running to make the conditions very severe and find what the system would stand.

Continuing, Witness said that if the G.B. people had known there was a lot of leakage they would have provided for that condition and no one would ever have heard of it in Court. The leakage was only found out during his tests.

Prof. Silvanus P. Thompson, D.Sc., said he was one of the inventors of the Thompson-Walker system of surface traction. He gave up his system because it was superseded by the G.B. system. He had no doubt that if the G.B. system was properly installed in the Mile End Road, it would work properly. He was indignant when he read the description of the G.B. system as a "live stud" system. "Wild rhetoric" was what he would call the description of "roasted horses" and fireworks at night. To say that the G.B. system was dangerous to man or beast would be extremely injurious to the G.B. Co.

Mr. A. P. Trotter, electrical adviser of the Board of Trade, said the trial run in the Mile End Road, at which he was present, was in the nature of a preliminary inspection. A high speed was attained, and no accident or ill-effect, mechanically, resulted. The arc extinguishing device worked satisfactorily.

Mr. Smith: You expressed yourself as satisfied with the result?—Yes.

Mr. Stephen Sellon, consulting engineer, said he had come to the conclusion that the G.B. system was an efficient system. He had advised the Corporation of Oxford to install the system after he had seen it at Lincoln, and he would not have advised that had he not been satisfied of its absolute safety.

Mr. Robert Weekes, consulting engineer, said it appeared to him that the slot-conduit system cost about 100 per cent. more for current than the G.B. system. The G.B. system was suitable for use in London. In the course of some discussion as to whether evidence of the comparative safety of tramways could be received as evidence, Witness remarked that several people were killed in Liverpool soon after the tramways opened there.

After minor evidence had been given by two employés of the G B. Co., Mr. Griffiths, who financed the G.B. patents, entered the witness-box, and proved by means of accounts that he had had some 50 orders from the London County Council since 1904. None of the orders were from Mr. Fitzmaurice's department. This evidence was tendered to refute the suggestion that Messrs. William Griffiths & Co. were on the black list of the L.C.C.

Sir Edward Clarke submitted that there was no case to go to the jury. The Judge having ruled against this,

Sir John Benn was called, and stated that he was not an expert, but he had paid particular attention to the working of surface-contact tramways, especially in Paris. For 20 years he had been a member of the L.C.C., and had been chairman of that body. He had been on the Highways Committee almost from the start of the Council. He had come to the conclusion that any stud system was too complicated and difficult for London. He did not go to Lincoln to see the G.B. system, but he was present at the midnight trial run in the Mile End Road. He saw people looking at the sparking on the cars, which he afterwards described as fireworks. He took steps to ascertain that his facts regarding the roasted horse were accurate. When he wrote one of the letters complained of, he was glad to recognise that the tramway policy associated with his party was justified, but beyond that he had no party feeling in the matter. He never intended to attack the plaintiffs' personal honour at any time.

Mr. Greer, K.C. (for the plaintiffs): It would be a great misfortune if a business firm came in and got a blow intended for your opponents?—Sir John Benn: I think that firms are liable to have the goods they offer made the subject of public discussion.

The Judge: Oh, dear, no.

Mr. McCardie (for the defendant): Every person is entitled to criticise fully what is supplied, and, if need be, condemn it.

The Judge: He must justify his words if he does. You must begin by getting your facts true; then you can comment. The question arises here—were the facts true?

Mr. Greer: I suggest to you it would be a great misfortune to any firm if they happened to be drawn into a political controversy?—Witness: That depends upon whether the discussion on their goods is fair.

They are as fair game, you think, as your political opponents?—They have their goods properly examined, and if discussion takes place, it is fair and honourable.

Ought that discussion to take place under the influence of party excitement, or ought it to be treated as a pure question of business?—A certain amount of party excitement is associated with most public bodies; it is one of the elements of public life.

Do you think it right to bring it to bear on whether some of the people have supplied proper goods or not?—I say if a party identifies itself with a particular article which is inimicable to the people's good, their name should be associated with the policy or article.

The Judge: Do you not think there is too much politics in the London County Council?

Sir John Benn: I think the Council would be a great deal better if politics could be eliminated.

The Judge and some of the jurymen: Hear, hear,

Mr. Greer: I may take it that the speeches and articles of which the plaintiffs complain were written to further the interests of the Progressive Party on the Council?—Witness: The party element in these speeches and letters was introduced as a reply to the very unpleasant charge in connection with the Progressive tramway policy—that the Progressives had squandered ratepayers' money. When the Moderates associated themselves with this system, we hit back. Witness stated that he thought what he had said was quite fair considering the materials before him. The officers' report told him that a serious accident had occurred to a horse, and that the conditions were so serious as to stop the service, and that, in the public interest, the system had to be abandoned.

Did you appreciate the fact that the statements you were making would seriously damage the G.B. Surface-Contact Co.?—If the system in the Mile End Road represented that to which you refer, that must be so.

The Judge: I think I had better write down the answer as "Yes."

Mr. Greer: It was not your business to write to the newspapers?—I think that in the interests of public safety it was my duty.

Sir John Benn maintained that what he intended to refer to was the stud system as laid down in the Mile End Road. He never referred to Lincoln. He did not know that the system could be made efficient, and he understood that it could only be used if Mr. Mordey's condenser was upon the cars, and a royalty was paid to Mr. Mordey for the use of it.

Mr. Henry Gordon, L.C.C., said he considered that the device on the car for discovering live studs did not adequately protect horses in a busy thoroughfare like the Mile End Road. Before the car could be brought to a standstill, its momentum would carry it several yards past the live stud, and when traffic was fast and dense, a horse could easily step on the stud in the interval.

Mr. A. L. C. Fell, chief officer of the L.C.C. tramways, who first entered the witness-box on Friday afternoon, said he had no personal interest in choosing one particular system. He wanted to get the best system for London.

Sir Edward Clarke: In your communications with Mr. Bedell did you act honestly to make the experiment a success?—Absolutely.

On Monday Mr. Fell was all day in the box. He said the G.B. Co. made the first magnet and the L.C.C. made the others. With the single magnet equipment which the G.B. Co. first proposed there were "violent fireworks" when the car was on the road. The magnet was apparently too short for the speeds at which the car was run. The G.B. Co. agreed that this was unsatisfactory, and they had many interviews with Mr. Bedell about it.

The Judge: Mr. Bedell said the magnet was too weak, and not too short.

Witness: It had nothing to do with weakness; it was too short. Continuing, he added that he heard Mr. Bedell say the insertion of a piece of gun metal in the outer pole made the magnets too weak. When this was taken out there was no difference in the pull of the magnets and the flashing continued. The question was raised whether a second magnet was not desirable, because it appeared that the short magnet was not sufficiently long to act upon two studs at one time. The magnet hardly got on to the second stud before the contact with the first one broke, and there was violent arcing between the stud and the chain. Eventually it was agreed that two skates should be used. The road running after the second magnet was fitted improved. Alterations in the cars were made to assist the G.B. Co. in getting their equipment on them. The track gear and all sorts of things were altered to try and get this equipment to work. Witness ordered 12 further equipments, but the Highways Committee refused to pass the order till the public running had started. The public running was not satisfactory. The system as it existed in the Mile End Road was not an efficient system. The difficulties increased as the bad weather came on, and eventually, on July 19th, he found it necessary to stop the running of the cars. Witness and Mr. Fitzmaurice sent a report to the Highways Committee, in which it was stated that there had been serious trouble with the system in the Mile End Road since the service started, and no fewer than 44 cast-iron stud heads had been broken by traffic; that many of the T pieces had been cracked; that there had been 927 live studs; that 728 of these had cleared themselves when hammered; that seven studs did not clear themselves; that 87 studs had been replaced; and that there had been five shocks, two to people and three to horses. It had not been exactly determined what was the extra amount of current required for the G.B. system as laid in the Mile End Road. The Highways Committee recommended the abandonment of the experiment, but the Council did not take exactly that view, and Mr. Mordey was appointed. Witness did not interfere with Mr. Mordey's experiments. Witness's opinion was that Mr. Mordey's experiments were not conclusive. In the early part of 1909 it was finally decided to abandon the line. The opinions in his reports to the Highways Committee were his honest opinions. He had never had any hostility to Mr. Griffiths or Mr. Bedell. The starting current of one of the Class E cars of the L.C.C. was about 55 amperes, and Mr. Bedell told witness he would design the resistance studs for 60 amperes. He had no recollection of 40 amperes ever being mentioned. It was within his own knowledge that 60 amperes could not pass through one of the resistance studs designed by Mr. Bedell for the Mile End Road. It had been stated that the experimental half mile was salted on one occasion, and that nothing else was salted. This he did not believe was the case. Horse cars were running over the route while the experiments were being carried out, and on horse tramways salting had to be carried out when there was snow or frost. The instructions as to salting were general.

Sir Edward Clarke: It has been suggested that you hammered the studs with the wicked idea of spoiling the studs?—The first time I saw a stud hammered was by Mr. Bedell.

Mr. Greer (for the defendant): It was not suggested it was done to destroy the system.

Witness: I have only once hammered studs in my life. I went out on March 17th to where a live stud was being taken up on the road, and I think I wished to demonstrate a theory I had that a horse with a sharp rap of the hoof could make a stud alive. I borrowed a hammer and tapped seven studs. Of these five became alive sufficiently to light the testing lamps.

The Judge: The evidence we have had is that a hammer would make a stud alive, but a horse would not.

Witness: I do not agree with that. In the early days there were considerable difficulties with the conduit system, but this he expected with any system applied to new conditions.

Mr. Greer: Supposing 50 per cent. of the studs in the Mile End Road were laid with the carbon too near the cable, that would not be a fair test?—Not on that particular point. Witness understood that plaintiffs had agreed with the contractor to supply the necessary supervision for the laying of the track.

The Judge: Mr. Fitzmaurice, I suppose, will answer for the track part of the case.—Witness said that was so. Pressed by Mr. Greer, he admitted that there would be a greater tendency to have live studs if the carbon was too near the cable.

Mr. Greer, referring to Mr. Mordey's experiments, pointed out that a speed of 27 miles an hour was obtained?—They did not get over the question of public safety.

They got over the arcing?—The arcing was not very bad when we had the two magnets during the public running. Witness said it was a "ridiculous" suggestion that the two skates, when placed only 3 in. apart, created a liability to arcing.

Mr. Greer: You take it upon yourself to say, with your knowledge of the system, that what Mr. Bedell says is ridiculous! Do you know that when they got a free hand, the great bulk of the difficulties disappeared?—I do not agree.

Replying to the suggestion that wear would have improved the track, witness said that wear cut both ways. Wear might break the springs and drop the carbons on the cable. After the G.B. Co. protested against the opening of the service for public running, he had an interview with Mr. Griffiths and Mr. Bedell, who seemed to infer that witness was having the inspection in order to get the system damned. He pointed out that there was not the slightest intention to get the system damned. On the conduit system, the witness admitted, they did not like salt. It was worse in a conduit system than mud. Very bad mud troubled them, too.

Mr. Greer: Have you ever known of a horse stepping on a stud making it into a live stud?—I believe that the horse which was killed by a stud was killed because the horse made it alive. The current had been cut off over night, and no car had passed over the stud.

You don't know anything about the horse having tapped that stud?—The horse was there, and I think the same thing happened at the accident which took place when Mr. Mordey's trials were on.

Mr. Greer suggested that a little pitch had made the stud sticky.

Mr. Fell did not accept the explanation as satisfactory, and pointed out that the same cross-overs might not be used by cars for months, and that it would be very serious if live studs developed in these cross-overs.

Mr. Greer: Did you form the opinion that Mr. Mordey's trials had shown that the system was more likely to be satisfactory than you had expected in July?—With his improvements it was better.

Your report says they were not conclusive in favour of the system?—Yes. What I mean was in connection with the condenser. If a stud was stuck and would not go down to the cable, the condenser would not operate on a live stud coming immediately afterwards. This was proved by passing the car over a dummy stud at a crossing, and the condenser failed at the next stud, which was alive.

I am not suggesting it is impossible for an accident to happen on this system, as accidents happen on all systems, but, with that exception, the condenser apparatus and the arc shunting apparatus worked satisfactorily?—The condenser apparatus depended upon such little things for its efficient working.

Mr. Mordey had been called in as a Court of Appeal from your judgment?—I have still my own opinion.

It remained the same, notwithstanding the reports and experiments of Mr. Mordey?—Yes.

You felt you had had enough with this system?—There was never such a suggestion.

The hearing was continued on Tuesday and Wednesday. On the latter day Counsel delivered their final speeches.

The jury found for plaintiffs on all issues except one, and awarded damages at £12,000. Judgment for each plaintiff for £6,000, but stay of execution pending appeal, on security being given for £5,000.

Midland Railway Co. *v.* General Electric Co., Ltd.

Before the Aston Bench on November 23rd, defendants were summoned, according to the *Birmingham Post*, that they being the owners of an electric stator in two parts, then being about to travel upon the Midland Railway, did unlawfully and wilfully give a false account of such goods by falsely describing the same as "two cases of bearers" with intent to avoid payment of certain tolls payable in respect thereof, at Erdington on September 15th. Charles Haigh, 72, Davey Road, Handsworth, a clerk in the firm's employ, was summoned for unlawfully giving a false account of the goods, and Ernest Wilson, Penns Lane, Erdington, the commercial manager, was summoned for abetting, counselling, and procuring Haigh to commit such offence.

Mr. Turner appeared for the railway company, and Mr. W. J. Disturnal for the defence.

Evidence was given as to the consignment of the goods to Bedford in cases, and to their being described as "bearers," under which they would be delivered at 9s. 2d. per ton, an exceptional rate at owner's risk for iron and steel. If they had been sent as "stators," they would have come under a different class of goods altogether, the rate for which was 22s. 9d. per ton, which meant that on the goods concerned, the charge would have been £10 2s. 6d. instead of £4 19s. 5d. Detective-Inspector Evans, of New Street Station, spoke to visiting the General Electric Co.'s Works at Witton and interviewing Mr. Wilson and Mr. Haigh in reference to the description of the goods. Mr. Wilson said he took all responsibility for any declaration of goods given to the railway company, and instructed Mr. Haigh to take witness into the yard at the works and show him some goods which, he said, were similar to those consigned. Haigh, thereupon, showed witness some castings which appeared to be covers for fly-wheels. There was nothing inside the castings, however, and, in consequence, they differed from the goods consigned as "bearers."

A number of expert witnesses stated that it was not correct, in their opinion, to describe the parts consigned as "bearers." Among these witnesses was William Pattison, an engineer, in the employ of Messrs. Allen & Co., of Bedford, who stated that his firm contracted with the Bedford Corporation to supply some electrical machinery, and in turn contracted with the General Electric Co., at Witton, for the supply of a single-phase alternator. When the two parts were delivered on September 19th, he simply had to fix them together with bolts and nuts. Otherwise, they were complete, and it was not correct to describe them as "bearers."

Mr. Disturnal, for the defence, contended that the defendants were perfectly entitled to consign the goods in the manner they had, and referred to the seriousness of such a charge being brought against a highly reputable firm occupying the position they did in the mercantile world; and also upon the fact that the railway company sent a detective down from their criminal investigation department to inquire into what was a purely commercial dispute. There was nothing in the nature of a fraudulent action, and the matter could well have been dealt with before a different tribunal. He called the commercial manager, Mr. Wilson, who stated that there had been disputes between the firm and the three railway companies with regard to the declaration of similar goods. They were very large consigners, but latterly their custom had, to a great extent, been transferred from the Midland to the London and North-Western and Great Western Railways. He had contended all along that it was right to describe these goods as "bearers," and send them at the corresponding rate.—Cross-examined, he admitted that he so described the goods in order to secure the cheaper rates, but adhered to the contention that they were perfectly within their right in doing so.

The Bench found that the description of the goods was false, made to secure a lower rate. They imposed a fine of £20 and costs on the General Electric Co., with £10 special costs. Mr. Turner thereupon withdrew the summonses against Mr. Wilson and Mr. Haigh.

Marconi and Others *v.* British Radio-Telegraph and Telephone Co.

Mr. T. Terrell, K.C., made a further application to Mr. Justice Parker in the Chancery Division, with reference to the hearing of this action. He said that it would be very convenient for the purpose of experiment that current should be taken by tapping the Court wires, and he wanted his Lordship's sanction to that being done. The jurisdiction to do it was in the superintendent, and they could take the current easily enough. The superintendent, however, would not do it without the authority of the Board of Works, and they would not give their authority until his Lordship had given permission. The burden of proof in the case was on the defendants, who would have to prove the validity of the patents, and it would, in their opinion, much facilitate the case if they had this current for the purposes of cross-examination. It would be quite easy to take the current from the corner of the Court, and all the arrangements would be under the superintendence of Prof. Boys. He asked his Lordship, therefore, to write to the Board of Works to the effect that it would be desirable that the current should be taken for the purposes of the case.

Mr. Walter, K.C., said that he did not mind in the least if his Lordship thought that it was necessary for the case.

Mr. Justice Parker said that he would authorise the parties to say to the Board of Works that, in his opinion, it would be convenient for the purposes of demonstrating to him the practicability of the invention and other purposes necessary for the trial, that the current should be taken.

Scarborough Tramways Co., Ltd.

An application came before the local justices on Wednesday last week, on behalf of the Edmondson's Electricity Corporation, Ltd., who asked for a summons against the Scarborough Tramways Co., Ltd., for the appointment of Mr. Charles Henry Jones, of Broad Sanctuary Chambers, Tothill Street, Westminster, the secretary of Edmondson's Electricity Corporation, as Receiver. The Receiver was to be in respect of arrears of interest in an indenture of mortgage dated February 10th, 1910, made between the Scarborough Tramways Co. and Edmondson's Electricity Corporation. A demand was made by registered letter on October 30th, 1910, for six months' interest, amounting to £625, due on August 1st, 1910, of which £110 only was paid on November 8th, leaving a balance of £515 owing. The application was made under Secs. 53 and 54 of the Land Clauses Act, and Sec. 9 of the Scarborough Tramways Act.

The application was granted, the summons being returnable on Friday of this week.

GENERATING ALTERNATING CURRENTS OF ANY FREQUENCY.

By Dr. ALFRED GRADENWITZ.

It is well known that alternators designed for a low frequency at a considerable pressure have generally to be constructed fairly large as compared with the output. Owing to their low speed they must have a very strong field, and consequently heavy iron parts. Thus the disadvantage of the ordinary machines of this type is due to the frequency being directly proportional to the speed, so that the low frequency entails a low speed.

An arrangement designed by the Felten & Guilleaume-Lahmeyerwerke is intended to eliminate this drawback by using for the generation of alternating currents of low frequency a type of machine in which the frequency is determined partly or wholly by the time-constant of the windings, while the speed of revolution exerts no influence, or only an indirect influence, on the frequency.

A phenomenon sometimes noted in connection with continuous-current plants is periodical fluctuation or "hunting." The frequency of these fluctuations depends mainly on the time-constant of windings that act on the current or are traversed by it. Whereas engineers have hitherto endeavoured to do away with these fluctuations, the new scheme consists of utilising such fluctuations generated by artificial means, and, if necessary, reinforced, for the generating of alternating currents, the frequency of which is low, being controlled at will within given limits by altering the time-constant, so that the same machine is able to yield alternating currents of lower or higher frequency.

A simple instance in which this scheme is used is represented in fig. 1. I and II are two machines which are driven by any means, either together or independently. Each of these machines has a shunt winding, *e* or *c*, and is driven in such a sense as to excite itself of its own accord. In addition to this, each machine has a field coil, *d* and *f*, which is excited by current from the other machine. In the arrangement represented by the figure, *e* and *f* and *c* and *d* can be connected up in series. Moreover, the winding *f* can be connected to the brushes *a a* of Machine I, and the winding *d* to the brushes *b b* of Machine II. This arrangement works as follows:—

The switch *g* being opened, Machine II will generate a current, the direction of which is indicated, say, by the symbols + and − on the brushes. To this direction corresponds in Machine II a field as indicated by the arrow beside the winding *c*, and a field in Machine I as indicated by the arrow beside the winding *d*. Machine II thus excites itself spontaneously, while yielding an external excitation for Machine I, generating at its brushes *a a* an E.M.F. the direction of which is again indicated by the symbols + and −.

Now, on closing the switch g, a current will flow from Machine I through its winding e and through the winding f of Machine II, which sets up in the machines electromagnetic fields of directions as indicated by the arrows. Whereas the field of winding e reinforces more and more the field of the winding d in Machine I, the field of the winding f will weaken that of the winding c in Machine II. This is why the E.M.F. of Machine I increases more and more, while that of Machine II is decreasing. If, now, the field of the winding f becomes equal to the field of the winding c, the E.M.F. of Machine II will become zero. At this moment, however, the current in the windings c and d is not yet reduced to zero, owing to the self-induction of the coils c and d, though it will decrease continually as the source of its generation, viz., the E.M.F. of Machine II, has disappeared. However, even during the decrease of the current traversing the windings c and d, the current in the winding f will increase as Machine I excites itself spontaneously by the winding e. While the field c thus decreases, the field of the winding f will increase, prevailing over the field of c, so as to produce a resultant field, the

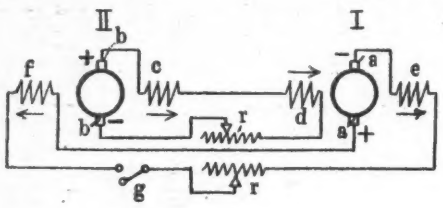


FIG. 1.

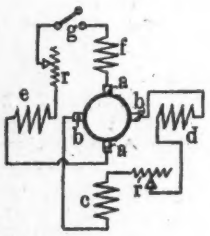


FIG. 2.

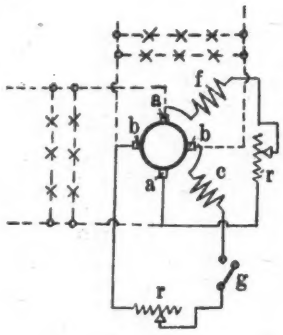


FIG. 3.

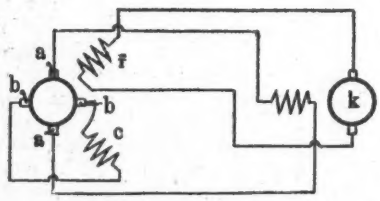


FIG. 4.

direction of which is opposite to the direction of the original effective field in Machine II. The polarity of Machine II is, therefore, reversed, and the decrease of the current in the windings c, d is accelerated, so that the current eventually becomes equal to zero.

Because of the reversal of polarity, the current afterwards changes direction. In Machine I the field of winding d now acts against the field in winding e, whereas in Machine II the winding f assists the winding c. The two machines thus exchange their previous *rôles*, and the reversal in direction of the current occurs at intervals which correspond mainly to the time-constant of the exciter coils, without any necessity of opening the switch g. By increasing or reducing the time-constant by any means, the frequency can be altered. In order to lower the frequency, there can, for instance, be inserted into the circuit a choking coil, and to increase it a condenser, or else short-circuited windings could be arranged in any magnetic dependence on the windings traversed by the current; or the number of turns of the coils traversed by the current can be altered. Another means of altering the frequency within wide limits is by shifting the brushes.

The resistances r represented in fig. 1 can be used for adjusting the machine, while being, if desired, designed as working resistances. Each of the machines may yield working current to an external system. The alternating currents supplied by the machines differ in phase by about 90°. The phases can be linked by well-known methods; there may thus be inserted working resistance between the brush $+ b$ and the brush $- a$ on the one hand, and $- b$ and $+ a$ on the other.

The two machines I and II can be combined, as represented in fig. 2, into a single machine, the brushes and windings of Machine II being located on Machine I, while being shifted through half a polar division from the brushes and windings of Machine I.

Fig. 3 represents a simplified arrangement of the machine shown in fig. 2, the windings c and d being combined in a single winding c; in a similar manner the windings e and f are combined in a single winding f.

In the arrangement represented in fig. 4, the winding f is not fed directly from the brushes $a a$, but from a special exciter machine k, which derives its excitation from the brushes a a of the main dynamo. The winding c can also be fed from a special exciter machine, deriving its excitation from the brushes b b of the main dynamo, and the two exciter machines can be combined in a single machine.

A rotary converter can be arranged according to this system, and it is suggested that this machine will find an important field of application for receiving from the rotor of an ordinary three-phase motor, slip-currents (which hitherto have been wasted), and restoring their energy, after conversion, to the supply system. The converter can be coupled to the three-phase motor.

The A.C. generator for variable low frequencies can be used to advantage in connection with sign-lighting, for actuating the various lamps of the system at adjustable intervals. It can also be used as an exciter for a dynamo designed in the manner of continuous-current machines, which will then be able to supply alternating currents of a frequency dependent on the frequency of excitation, while being practically independent of the speed and the voltage of the machine.

The generator can also be used for the operation of all kinds of machine-tools requiring a reciprocating motion, such as riveters, rock drills, planers and even rolling mills and the like, by altering, *e.g.*, by its means, the excitation of the driving motor.

The generator can be readily operated from a system of constant frequency at a frequency adjustable by altering the ratio between the speed and the frequency.

CONTROL AND INSPECTION.

By W. O. HORSNAILL, A.M.I.Mech.E., A.M.I.E.E.

THE systematic control of manufacturing operations and the inspection of the results are so closely allied that one cannot be considered without the other. In fact, the two departments are not infrequently combined under one authority and accommodated in one enclosure.

It is necessary, even in the smallest concerns, to institute some simple system for expediting the work, keeping track of the progress and recording the costs, whilst inspection in some form or another has long been considered essential.

Centralisation is known to promote efficiency, and in large undertakings the control and inspection staffs are generally centralised and combined in one department.

Whether inspection and control after each operation are actually carried out within this central enclosure depends upon the nature of the work, but there is a tendency in this direction, as it is found that with overhead cranes and shop tramways, comparatively heavy work can be so treated with advantage. Large castings and forgings weighing several tons must necessarily be inspected at the machines and passed on direct for subsequent operations until they reach the erecting stage, but they may still be dealt with from the central control and inspection department and not by

isolated inspectors. Where repetition work is done by the piece and only paid for when passed by the inspecting staff, less friction is likely to be caused if the work is checked in a separate department and by inspectors who do not even know to whom the blame attaches when parts have to be rejected. Their duty is simply to report to the head of the department, who, after verification, will pass on the complaint to the works manager.

Repetition piecework seldom extends to very heavy castings or forgings, hence the drawback attached to inspection of such parts at the machines does not apply.

Advantage is taken of the return of the work to a central department for inspection, to control and record its progress through the various shops. This plan also avoids the storage of half-finished products amongst the machines, as such are only issued to the foremen as required. Moreover, the necessary jigs, tools and instructions are got together in the control department, so that the foremen's duties are confined to keeping their men employed, maintaining discipline and giving any necessary explanation or assistance.

This combination of control, with inspection in a central department, greatly facilitates the records of progress, as one copy of each inspection-ticket can be handed over for entry upon a list of parts, which will, therefore, show the work done up to date. It is now almost a universal practice to make out a list specifying every part in connection with each order, and, in addition to the usual reference numbers, &c., the "control" list will show the various operations needed, with blanks for filling in the dates when each job is completed. These lists, therefore, indicate how much more work has to be done on each order, as well as the amount finished. Another feature of this control system is the ordering of material for stock orders by the control staff upon receipt of their list of parts. This plan entails a close connection with the material stores, and in at least one recently laid out works these stores have been amalgamated with the control and inspection departments. In addition to the advantage of proximity to the demand, the services of the inspecting staff are at once available for checking the quality of material when received. Much of this work must be done by skilled inspectors in any case, hence time is saved by having them located on the spot.

The arrangements indicated above naturally take up a great deal of space and demand very efficient handling facilities. Probably the best lay-out consists of bays for the different shops, with the stores, control and inspection departments arranged across the ends, the crane runways being carried right through. The addition of shop tramways running into the control department at various points should provide sufficient facilities for handling the material. These appliances may, however, often be advantageously supplemented by trolleys, which can be loaded with the parts to be operated upon and run up alongside the machines or benches, from whence they are returned to the control stores when the work is completed.

It is doubtful whether the final inspection of the finished machines should be done by this department at all, and some firms now employ separate inspectors, who are responsible to the selling branch of the business for all work passed into warehouse. As a general principle, work should be inspected by someone who is in no way responsible for its production; but this would not be the case if the final passing were done by the inspectors of parts, who might be blameable for defects in the finished product, hence the advantage of having this work done by a separate authority.

The principles indicated above are advantageous right through, from the smallest up to the largest concerns, although in small undertakings the arrangements will necessarily be modified. Even with a dozen to 20 men the work should be checked by someone, and the jobs must be laid out with instructions and tools ready for operating upon. Return to the control stores after each operation would not, however, be advisable; but the materials and tools should certainly be housed in the enclosure used for laying out and checking the work.

Those in authority over large engineering works are now mostly alive to the need for some such system as we have described, but it is to be feared that many medium and small concerns are still muddling along in the old-fashioned way.

BUSINESS NOTES.

The Electric Supply Publicity Committee.—The Electric Supply Publicity Committee are now making a further issue consisting of a leaflet on the use of electric radiators, of handy size, suitable for being enclosed with accounts, correspondence, &c., to consumers; an electric radiator leaflet, with comparative illustrations showing the disadvantages of a coal fire and the great convenience of an electric radiator; radiator mail-card on the same lines, suitable for use as postcard; adhesive labels, illustrating electric heating, electric ironing, and electric power, in colours, suitable for attaching to letters, accounts, &c., forming an inexpensive means of advertising particular uses of electricity; cooking leaflet showing illustration of up-to-date cooking apparatus and detailing advantages; leaflet, entitled "Electric Light and Health," giving medical and other testimonies, urging the hygienic advantages of electric light; calendar, attractively lithographed in colours, of a convenient size so as to facilitate distribution, and ornamental so as to ensure its being kept by the recipient. The calendar forms an excellent method of advertising, since it lasts longer than other forms.

Patent Surrender.—According to a notice in the *London Gazette* Siemens-Schuckert Werke, G.m.b.H., have offered to surrender Patent No. 18,328 of 1909, for "Improvements in flame arc electric lamps." Any person desiring to be heard in respect of the surrender must notify the Comptroller-General by December 23rd.

Catalogues and Lists.—Messrs. Holophane, Ltd., 12, Carteret Street, Westminster, S.W.—"Holophane Illumination," is the title of a 12-page business publication just issued for November (Vol. I, No. 1). The pictures include views of a London electric supply showroom, where a representative display of Holophane reflectors is to be seen, and among the matters covered are the following:—New "Stiletto Prism" reflectors; Holophane for church lighting; Holophane homilies—the contractors' opportunity.

Callender's Cable & Construction Co., Ltd., Hamilton House, Victoria Embankment, London, W.C.—We are writing this with a new self-filling fountain pen received from Messrs. Callender, and though we have not very much to say—it is not necessary—the ink flows so freely and the pen writes so easily that it would be ungrateful not to say so. While we write, if the flow becomes insufficient, we have only to turn the little wheel at the end and it comes on again—of course, if we have taken the precaution to see that the reservoir was full before we began. When we finish, we stop the flow by turning the screw the opposite way, as we really ought to do now in finishing this note. But we must add that the large number of the company's customers and friends who make use of these pens will always be in such a happy frame of mind that they will be following the advice printed on the pen, which is to "Use Callender's Kalbitum paint," and they will with this very pen at once write out orders for that self-same specially-prepared paint. Little gifts of this kind go a long way—next, please.

Messrs. Benetfink & Co., Ltd., 107-108, Cheapside, London, E.C.—Catalogue of Osram lamps and prices of same.

The Electric and Ordnance Accessories Co., Ltd., Cheston Road, Aston, Birmingham.—Small folder giving particulars and prices of the "Eclipse" electric heaters, also small illustrations of a number of types. Quantities of these folders can be supplied to contractors with their own name and address, for distribution to their customers.

Messrs. Pope's Electric Lamp Co., Ltd., Hythe Road, Willesden.—Picture postcards has been issued to advertise the Pope metal-filament lamps. The Sphinx is represented up-lifting one of these latter-day lamps to reveal in a true light the charms of a matchless beauty. We suppose that the only thing in common between the "Sphinx" and the "Pope" lamps is *the* thing that the card is intended to advertise—namely, that *they last*. The words "British made" relate to the lamps—we have not heard that claim set up regarding the "Sphinx."

Mr. H. H. Cressall, 13, Summer Row, Birmingham.—Large wall-sheet giving a great deal of information with illustrations, in connection with Schniewindt's patent asbestos woven resistance nets, for which he is sole agent in England. Tabulated particulars appear of resistance wires, motor-starter resistance nets, resistance cord, woven-wire resistance bands, &c., also prices of same. The posters are intended for hanging up for reference in drawing offices of works interested in these specialities. Copies of the poster, together with price lists and samples of resistance nets, will be sent on application.

The Pearson Fire Alarm, Ltd., Jewin House, Redcross Street, London, E.C.—New pamphlet containing a description of the Pearson automatic fire alarm and fire extinguishing appliances. A list of the more important buildings protected by this apparatus, is given, the Mansion House, London, appearing among them. Testimonials are included from firms in whose premises the system has proved its efficacy owing to promptness of action.

Midland Electric Manufacturing Co., Ltd.—Booklet, being a collection of leaflets issued by the firm, dealing particularly with their special lines:—Switchboards, distributing boards, fuseboards,

ironclad switches, fuses and fuseboards, the M.E.M. standard accumulator board and motor-control panels. These specialities are each clearly illustrated and priced.

Messrs. Longstreths, Ltd., 190, Queen's Road, Battersea, London, S.W.—Leaflet relating to Lithanode 4-volt car lamps.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—A collection of four new catalogues of machinery (P section) have been received dealing respectively with continuous-current dynamos and motors and alternating-current generators and motors. We congratulate the company upon the attractive appearance of these catalogues both inside and out, and their general neatness and completeness. They are printed in two colours and have differently coloured covers. Each list is prefaced by a general and technical description followed by a complete specification. The tabulated price lists are so arranged that a complete price of machines, together with accessories, can be easily found. The continuous-current dynamos are listed under two headings—high-speed and low-speed. Separate tables are given for generators specially suitable for Osram lamp installations where accumulators are used. For motor-driven series boosters prices of the complete machines are given, rotary and static balancers being also included. The alternating-current generator list commences with a general and technical description of Witton alternators followed by two specifications—one of engine-driven alternators and the other of turbo-alternators. This list does not contain prices, as the requirements for alternators are so diverse. The speeds, weights, efficiencies and outputs, are given of the standard machines for 25, 40 and 50 cycles, and the last three pages are devoted to illustrations of machines made by the company. The continuous-current motor catalogue follows a similar plan to the continuous-current dynamo catalogue. Prices are given for constant speed machines in the semi-enclosed, enclosed ventilated, and totally enclosed types, for constant and crane rating. A table of variable speed machines follows, will full particulars and prices. Following the spare parts and dimension drawings there are connections of standard machines of the different types. This section is concluded with three pages giving the powers required to drive various machinery used in several industries. The alternating current motor list lists motors for 25, 40, 50 and 60 cycles—two and three-phase—and 50 cycles single-phase; in each case the horse-power ranges from about ½-H.P. up to 100. Prices are given for slip-ring and squirrel-cage motors, slide rails, open and closed starters, and auto-transformers. Columns of efficiencies, power factors, dimensions of standard pulleys and full-load speeds, complete the tables. A complete price list of spare parts is given in these lists, also dimension drawings. The dimensions and weights throughout are given in English and metric units—a useful feature.

Second edition of list No. F1,429, giving in the course of twenty-four pages, illustrations, prices, &c., of their various lanterns and reflectors for shop window and picture illumination. A number of pages show a varied selection of advertising signs. "Striplite" and "Pixielite" strip and illumination devices are included, also the "Avenue" series of shop lighting fittings and many other designs for "Osram" lighting.

We have also received from this company a copy of an advance booklet giving particulars and illustrations of their "Electric Kleenall" for simplifying the work of the domestics in the home. It is claimed to be a good selling line which dooms the broom to oblivion. It requires no special fitting, and is supplied for D.C. or A.C., and can be used wherever electric supply is installed. This "Kleenall" embodies improvements over the type introduced by the company some months ago, and it is considered to be a good line for contractors to push among "Christmas Gifts."

The Paterson Engineering Co., Ltd., Amberley House, Norfolk Street, London, W.C.—New edition (48 pages) of their Paterson Red Book on water softening and purifying for steam-raising and industrial purposes, for 1911. It is fully illustrated by half-tone blocks and line diagrams, and contains a great deal of reading matter which should be of interest to power station engineers. Among the illustrations is one showing the Paterson oil eliminator at the Cape Electric Tramway generating station fitted with a recorder giving a continuous record of the water purified. A lengthy list of users occupies a number of pages.

Messrs. Crompton & Co., Ltd., Salisbury House, London Wall, E.C.—Thirty-two page catalogue (D 25) in their standard form for filing, giving exhaustive information, both descriptive and tabular, of their continuous-current dynamos (open type). Prices are given in detail.

Messrs. S. H. Heywood & Co., Ltd., Reddish, near Stockport.—Forty-page pamphlet containing descriptive matter relating to, and many half-tone illustrations showing, their electric cranes, overhead travellers, fixed and walking jibs, Goliath and wharf cranes.

Messrs. Siemens Bros. Dynamo Works Co., Ltd., Tyssen Street, Dalston, N.E.—Revised price list No. 4A8 relating to "Onewatt" lamps. Contractors can have quantities with their name on as usual. The company is now placing upon the market a 200-C.P. "Onewatt" lamps for voltages from 100 to 130, and 200 to 250. The efficiency, we understand, will be the same as that of the 100-C.P. Onewatts at present on the market, and the filaments are made of drawn tungsten wire. These lamps will be supplied with E.S. or B.C. caps as required, in spherical bulbs only, 3½ in. diameter.

Mr. G. Braulik, 8, Lambeth Hill, E.C.—New price leaflets of Eclipse" metallic-filament lamps, and small electric novelties such as motors, induction coils, bells, &c.

The Rauch & Lang Carriage Co., Cleveland, Ohio.—Artistically designed and well-produced brochure of 24 pages, containing neat pictures and descriptive matter relating to the R. & L. electric automobiles, Stanhopes, Coupés, Victorias, Runabouts, &c.

Messrs. Schaffer & Budenberg, Ltd., Whitworth Street, London Road, Manchester.—Descriptive leaflet illustrating their patent "Concentra" mechanical oil pump, and stating prices.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.—New catalogue (No. 532, 44 pages, art paper) devoted to their "vulcanised india-rubber wires and cables," and superseding the provisional catalogue of the same title published in October and all previous publications on the subject. It contains, besides the usual Association and non-Association wires and cables, a special section dealing with bell wires and flexible wires for electric light, &c. Amongst the latter, attention may be directed to their new "Besto" fire-resisting flexible twin wires which have been put on the market owing to the demand for special twin flexibles for shop-window lighting. The "Besto" flexibles are claimed to be less clumsy than the ordinary asbestos-covered wires, because, whilst the latter are covered with braided asbestos, the new wires have the asbestos spun on them direct by a special process, for which Messrs. Siemens hold the patents. The catalogue contains, in addition, some practical tables for the use of those engaged in wiring work, and some excellent half-tone illustrations of the Woolwich Works where all the wires and cables are made.

The Brush Electrical Engineering Co., Ltd., 1, Kingsway, London, W.C.—A showcard prepared for standing constantly under one's gaze on the desk or wherever there may happen to be room, bringing to one's mind the "Metallum," "Quartzlite" and flame and enclosed lamps of the Brush Co. We do not know whether the four charming damsels are all all-the-time extolling the virtues of all the lamps, or whether with the "Bright quartette" of lamps and ladies, each has an individual preference. We have no clue as to which prefers which, but the card is exceedingly attractive—and it has no colour about it.

Installations in Yorkshire.—Mr. H. Moss, of Bradford, is at present installing electric lighting throughout Emley Old Hall, near Wakefield, the supply for which is to be obtained from the overhead mains of the Yorkshire Electric Power Co.; he is also installing electric lighting and ventilating fans in the new premises of the Woolsorters' National Union, Bradford.

Buenos Ayres Centenary Exhibition.—The judges of this Exhibition have awarded a silver medal and diploma to Messrs. W. B. Brown & Co. (Bankhall), Ltd., for their steel wire ropes for mining works, elevators, ships and steamers' use.

Messrs. Alfred Herbert, Ltd., of Coventry, have been awarded the Grand Prix in connection with their exhibit at this exhibition.

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell will, on December 13th, sell by auction a quantity of machine tools, electrical and other plant. See our advertisement pages in this issue.

Trade Announcements.—Mr. T. A. Nunwick, for many years chief representative for Messrs. Dorman & Smith, has resigned that position to take up a similar appointment on Monday next on the staff of Messrs. Parmiter, Hope & Sugden, of Manchester. This necessitates his relinquishing the various agencies which he has held during the past two or three years; but as Messrs. Parmiter, Hope & Sugden are the selling agents in Lancashire, Yorkshire, Cheshire and North Wales for the Gilbert Arc Lamp Co., Ltd., Chingford, and also for Messrs. Metalite, Ltd., London, he will represent these firms also.

Mr. Samuel Hartford having commenced business on his own account, has taken offices at 67, Lord Street, Liverpool, where any communications should be addressed.

Messrs. Harold A. Neale & George J. Freund have just commenced business on their own account as Neale & Freund at 31, Budge Row, Cannon Street, London, E.C. Both gentlemen have just severed their connection with the contract department of Messrs. Crompton & Co., Ltd., of London and Chelmsford, Mr. Neal having been in charge of that department for the last few years. The new firm will specialise in electric lighting and power equipment for factories and workshops, and country house lighting installations; they will also be engaged as exporters of plant.

Private Meeting.—Ernest Roberts, electrical engineer, 3, Holborn Place, London, W.C.—A meeting of creditors was held last week, when a statement of affairs was presented showing the position as at November 24th last. The liabilities amounted to £790, all of which were due to unsecured creditors. The assets were estimated to realise £944, less £38 for the claims of preference creditors, leaving net assets of £906. The estate thus showed an apparent surplus of £116. It was reported that the debtor started in business for himself about thirteen years ago, with a capital of £100, which was lent to him by his father. Subsequently his father died, leaving the debtor a sum of £100, so that the money which had been advanced became a gift. At one time the debtor entered into partnership with another man, but no deed of partnership was drawn up. Later there was a slight disagreement between the

parties, and his partner then retired. He paid his outgoing partner a sum of £200 on going out. During the last two years the business had shown a falling off. This the debtor attributed to bad debts, and to the loss of the manager who had been with him for some years. Owing to the loss of his manager, the debtor, who had previously been travelling, was obliged to discontinue this and to go into the warehouse to superintend matters. With regard to the turnover of the business, it was stated that this had been in the neighbourhood of £4,000 a year, upon which it was estimated that a gross profit at the rate of 15 per cent. was made. The expenses of the business had been a little over £400 a year, while the drawings had been at the rate of £3 a week. A deed of assignment had previously been executed to Mr. G. E. Corfield, of Messrs. Corfield & Cripwell, accountants, of Finsbury Pavement House, E.C. After a short discussion, it was decided to confirm this deed, and a committee of inspection was also appointed consisting of the representatives of the following firms: Messrs. Nalder Bros. & Thompson, the General Electric Co., Messrs. Krupka & Jaccby, Messrs. Allan and Co., and Messrs. Siemens Bros.

Fire.—A correspondent states that considerable damage was done by fire which broke out in the engine house providing the electric supply at Lauriston Castle, Mid-Lothian.

Electricity in Agriculture.—Replying to the letter of our correspondent "F. A. L.," the AGRICULTURAL ELECTRIC DISCHARGE CO., LTD., of 3, Howard Street, Gloucester, who are the sole licensees for agricultural application of Sir Oliver Lodge's high-tension discharge patents, write stating that they have fitted up an installation for Mr. Wm. Low, of Balmakewan, N.B. This is the only large scale installation in this country, apart from their experimental installations. They have also supplied apparatus for several installations abroad. Their letter unfortunately arrived too late for inclusion in our "Correspondence" columns.

Dissolutions.—SCOTT & LEGGATT, consulting engineers, 102, St. Mary Street, Cardiff.—Messrs. W. A. Scott and J. Leggatt have dissolved partnership. Mr. Scott will continue the business as Wm. Angus Scott & Partners.

SIMPKIN, WILKINSON & GIBSON, electrical engineers, 66, Kirkstall Road, Leeds.—Messrs. F. Simpkin and C. Gibson have dissolved partnership. Mr. Simpkin, 18, County Street, York Road, Leeds, attends to debts.

THE ALBION MOTOR AND ENGINEERING CO., motor and electrical engineers, Millbridge, Liversedge.—Messrs. L. C. Parkin, A. B. Parkin, and G. F. Watson, have dissolved partnership. Mr. Watson will attend to debts and continue the business under the same style.

Book Notices.—*The Mechanical World Electrical Pocket-Book for* 1911. Manchester: Emmott & Co., Ltd. Price 6d. net. —By condensing the descriptive matter—which is so often overdone in "pocket-books" nowadays, rendering them too much like text-books—room has been made in this issue for a large number of new tables, as well as other useful matter. The contents cover a remarkably wide field.

"Les Substances Isolantes et les Methodes d'Isolement Utilisées dans l'Industrie Electrique." By Jean Escard. 1911. Paris: Gauthier-Villars. Price 10 fr.

"Les Enroulements Industriels des Machines à Courant Continu et à Courants Alternatifs." By Paul Janet. 1911. Paris: Gauthier-Villars. Price 3.25 fr.

The *Official Circular* of the Tramways and Light Railways Association for November contains a reply by Prof. Ernest Wilson, of King's College, to Mr. A. J. Panton's remarks on Brake Shoe Standardisation; also a translation of M. Schorling's paper on Rail Cleaning, which was read at the Brussels Congress.

LIGHTING and POWER NOTES.

Acton.—The result of the referendum (says our local correspondent) must have occasioned no little surprise to those members of the Council whose proud boast it has been that in the decision to transfer the electricity undertaking to the Metropolitan Electric Supply Co., Ltd., "they had the support of the large body of ratepayers." In all 12,312 reply-paid postcards were sent out, and about one-third came back. In favour of the transfer there voted, 2,218, and against 2,024, a majority of 194. Upon this, the chairman of the Council sealed the agreement with the company, which has since taken the preliminary steps for the promotion of a Bill in Parliament. It is expected that the opposition to the Bill, when it reaches Parliament, will be of a most strenuous character.

Amersham.—The Uxbridge Electricity Supply Co. has applied to the B. of T. for an order to transfer its undertaking to Callender's Cable and Construction Co.

Beckenham.—The U.D.C. has assented to tradesmen in Beckenham Road illuminating the thoroughfare at Christmas time by means of arc and other lamps suspended overhead.

Braunton (Devon).—The P.C. has provisionally agreed to have the parish lighted by electricity when current is available—probably by August next.

Brighton.—Mr. Christie, the Corporation electrical engineer, having suggested the desirability of holding an electrical exhibition, the Committee has agreed to provide a stall in the Aquarium, and to co-operate with the local contractors in providing an exhibition there, for a month in the autumn of 1911.

Cardiff.—Mr. A. Ellis, the Corporation electrical engineer, pointed out in Committee that, notwithstanding the fact that the gas company is prepared to pay the whole cost of gas piping in a new house, builders often preferred to pay for electric wiring, so as to secure the electric light; this was especially so on the Penylan Estate.

Carlisle.—The T.C. is applying to the L.G.B. for a prov. order for E.L. in the district of the R.D.C. within a radius of two miles from Carlisle Cathedral. This district is being largely developed for building purposes.

Continental Notes.—SWEDEN.—H.M. Minister at Stockholm reports that the new electric works at the Trollhättan Falls have been opened. When the eight turbines and generators are constructed, for which the water supply is ready, the amount of electrical energy available will be 80,000 H.P. It is calculated that, by the construction of new works on the river and the lake, 180,000 H.P. can be obtained. Many of the towns and villages in the neighbourhood of the Falls are supplied with power; in the immediate neighbourhood, mills, &c., are already prepared, as well as the electric smelting apparatus installed by the Swedish Iron and Steel Institute, and preparations are also being made with a view to the electrification of the railway. It appears that at present the actual demand does not exceed 10,000 H.P., but it is expected to be much increased in the near future, though not above 30,000 H.P. It seems likely that electrical energy will be used in small quantities for local industries and agriculture, as is the case in Denmark.

The budget of the State water and electric works at Trollhättan for 1911, estimates the receipts at £57,000 and the expenditure at £24,000, leaving a surplus of £33,000 on a total capital expenditure of £850,000.

Considerable progress is being made with the railway to the Porjus Falls in North Sweden, and it is expected that hydro-electric work at the Falls will be begun next spring.

A measure is to be submitted to the Riksdag to provide a grant for making a complete survey of all the waterfalls of Sweden, and obtaining full particulars as to the best method of exploiting them.—*B. of T. Journal.*

SPAIN.—The municipal authorities of Jerez de los Caballeros (province of Badajoz) have just invited tenders for the concession for the electric lighting of the town during a period of eight years.

Croydon.—The Electricity Committee has been authorised to have plans and estimates prepared for anticipated requirements in new mains and transformers for the ensuing three years.

Donaghadee.—A special meeting of the Council was held recently, for the purpose of considering the question of taking the necessary steps to obtain a prov. order for electric lighting. The town clerk read the reports and information submitted by the electrical engineers, Messrs. Wilkins & Burden, of Dublin, on the proposed scheme, which showed that they had based their estimate of probable revenue upon a charge of 6d. per unit to private and business consumers. They estimated that the net profit for the year would be £290 10s., after deducting the total works cost and interest and sinking fund. The total capital expenditure within the district might be taken as under £3,900, but it would be possible to reduce this amount in the initial stages by installing only one generating set, and adding another according to the rate at which customers were connected to the mains. Great importance was attached to the fact that the pumping in connection with the proposed water supply could be carried out from the generating station. After a lengthy discussion, a motion was finally adopted to proceed with the application for the prov. order.

Edinburgh.—The Corporation Electric Lighting Committee has again discussed the disposal of the electric lighting surplus of £7,300 for the past year. The Town Council refused to adopt the Committee's previous suggestion that the surplus should be applied towards the reduction of the capital borrowed for electricity purposes, but remitted the matter back to the Committee to obtain a report from the Town Clerk and City Chamberlain. This report explained that the rearrangement of the plant at Dewar Place in connection with the condensing scheme will involve the scrapping of a portion of the present plant, and its replacement by newer and more economical machinery. The expenditure to be incurrred immediately in connection with the condensation scheme is estimated at about £45,000. To the extent of £37,000 it is new and additional, and therefore legitimately capital expenditure which may be met out of moneys to be borrowed. To the extent of £8,000 it is "replacement." The Committee had to decide whether it would treat this as revenue or as capital expenditure. After a long discussion, the Committee agreed to recommend that the Council apply to the Secretary of Scotland for consent to borrow £37,000, the amount of new and additional expenditure required, and that the sum of £8,000 required for replacing the plant to be scrapped be made up out of revenue, and that the disposal of the surplus be deferred until next May.

Finchley.—The L.G.B. has decided to hold an inquiry with regard to the application of the Council for sanction to borrow £10,000 for mains, house services and meters.

Glasgow.—The T.C.'s Finance Committee has appointed a deputation to wait upon the Electricity Committee, with a view to obtaining a free supply of energy to all the public clocks in the city in the charge of the Corporation which are at present lighted by electricity.

Hanwell.—Twelve flame arc lamps in the Hanwell Road are to be replaced by 30 400-C.P. incandescent lamps. Half of the lamps are to be turned out at midnight and the remaining 15 are to burn the schedule number of hours for street lamps. The incandescent lamps are to be fixed on alternate tramway poles on either side of road. The change has been made at the suggestion of the Metropolitan Electric Supply Co., Ltd., and the system of incandescent lighting for the main roads is to be adopted throughout.

Heckmondwike.—A L.G.B. inquiry, lasting three hours, was held by Mr. H. R. Hooper on November 23rd, into the application of the U.D.C. for a loan of £24,159 for electricity purposes. This included £20,000 in respect of excess expenditure, and the Inspector, who expressed dissatisfaction with the accounts, adjourned the inquiry *sine die* for the production of information as to how the expenditure had been incurred.

High Wycombe.—The Electric Light and Power Co. has applied to the B. of T. for an order to enable it to supply electricity in parts of the borough not now included in the area of supply, and also in the parishes of West Wycombe, Chepping Wycombe Rural, and Hughenden.

India.—According to the *Indian Textile Journal*, the Tata Hydro-Electric Power Co. was recently registered with a nominal capital of 20,000,000 rupees. The completed scheme will supply 30,000 H.P. to Bombay; plans are now being prepared, and as soon as possible the construction work at Lonavla will be taken in hand. The services of Mr. H. P. Gibbs, of the Cauvery Falls scheme, have been engaged, and Mr. Alfred Dickinson, will continue to act in a consulting capacity.

The same journal for October contained the following paragraph:—"Mr. H. R. Speyer, A.M.I.E.E., chief engineer and agent for the Lahmeyer Electrical Co., Ltd., is now in Bombay to complete the negotiations recently initiated by him for the contract of the Tata Hydro-Electric scheme."

Japan.—A scheme is under consideration to put down a plant to utilise the water-power of Lake Inawashiro, in Aizu, about 170 miles from Tokio. The lake is at a high level, and it is estimated that from 30,000 to 40,000 H.P. would be available.

Leicester.—The T.C. is applying to the L.G.B. for a loan of £12,000 for cables and works in connection with the supply of energy for power. It is also intended to apply to the B. of T. for an order extending the area of supply to districts adjacent to the borough.

London.—ISLINGTON.—The borough engineer, replying to a question, has stated that the annual amount spent in the borough for public lighting, including cost of maintenance, was £28,337. About 100 miles of streets were lighted by gas at a cost, including maintenance of £13,112, and 24 miles of main streets were lighted by electricity at a cost, including maintenance, of £15,225.

Loughborough.—The T.C. has been recommended to convert the gas lamps along the route of the electric mains to electric incandescent lamps, on the following terms: Lighting and maintenance, £2 18s. 6d. per lamp per annum for the first three years, to include cost of conversion; afterwards £2 15s. per lamp per annum. The Highway Committee, which recommended the change, has been requested to reconsider the matter.

Mansfield.—The T.C. has decided to take no action as to supporting the Bill of the I.M.E.A. seeking powers to enable local authorities to deal in fittings, lamps, &c., and to undertake wiring work.

Newport (Mon.).—The T.C. has received from the L.G.B. sanction to a loan of £31,000 for additional plant, subject to accumulated losses of £3,500 being paid off out of revenue or out of the rates.

Pickering.—The B. of T. has revoked the 1901 prov. order.

Portishead.—Messrs. Christy Bros. & Co., Ltd., of Chelmsford, have applied to the B. of T. for a prov. order for E.L. in the area of the U.D.C., and in several parishes in the district of the R.D.C.

South Africa.—Recently at Maritzburg, a young lady received a severe shock through walking into an area which was apparently electrically alive, owing to a leak from the underground mains. Several attempts were made to rescue her, and eventually with success. This is the first accident of this kind during the 14 years the installation has been in use.

Southampton.—A shop front is to be put in the electrical showroom at an approximate cost of £250. The electrical engineer submitted to his Committee three schemes, in detail, in regard to the putting into practice of the powers recently obtained under the Southampton Corporation Act, 1910, for providing electrical fittings. He recommended a scheme whereby the cost of installation plus 10 per cent. could be repaid to the Corporation in 12 equal quarterly payments. The price paid to the wiring contractors is to be according to schedule for various classes of premises. The consumer is to pay outright for lamps, shades and special fittings and repairs or renewals. The recommendation of the electrical engineer is to be adopted. The electrical engineer further suggested that as regards the hiring out and rentals of motors and radiators, that a charge of 20 per cent. prime cost of the motor and other gear be charged as rent per annum, and in connection with radiators a rental of 5s. per annum, the consumer to maintain same. The Committee resolved that for the hiring out of motors of a cost not exceeding £100, a rental of not less than 20 per cent. of the prime cost be charged per annum, and that the hiring of motors costing above £100 be by special arrangement, ordinary wear and tear renewals being free. A rental of 10s. per annum is to be charged for radiators.

Stalybridge.—The Stalybridge Tramways and Electricity Board has entered into an agreement with the Calico Printers' Association, Ltd., for the supply of electrical energy to the Carrbrook print works.

Walthamstow.—The Electricity Committee has decided that, from the end of November, 1910, a fixed charge of 2d. per unit be made for electricity consumed in bioscope lanterns and for the illumination of signs taking not less than 3 amperes, and that the ordinary rates be charged for the lighting of cinematograph theatres.

Willaston (near Crewe).—The Parish Council has passed a resolution in favour of its undertaking the lighting of the township under the provisions of the E.L. Act of 1883.

TRAMWAY and RAILWAY NOTES.

Argentina.—The electrification of the Tranvia Nacional (Tetamarti), of La Plata, is being pushed ahead, and it is hoped to have the first section open by January next.—*Review of the River Plate.*

Belfast.—At a special meeting of the Corporation, last week, the construction of the M'Art's Fort tramway extension came up for discussion. A motion to omit the extension in the Bill being drafted, was carried by 16 votes to 10. This ends the scheme of the mountain tramway and the mountain suburb for the present.

Brighton.—The T.C. has decided against a private company introducing trolley omnibuses into the borough, that any such powers should be obtained by the Council, and that it is at present premature to obtain such powers.

Continental Notes.—GERMANY.—Plans are being prepared in respect of a projected light electric railway between Alsum-am-Rhein and Sterkrade.

RUSSIA.—Good progress is being made with the conversion of the tramways in the city of Odessa to electric traction. Over 30 miles of the new track has already been laid, and the power station is expected to be completed by the end of the present year.

ITALY.—La Société des Tramways Napolitans, which has already 111 km. of electric tramways in operation in the Naples district, has secured a concession from the local authorities for the construction of 40 km. of additional lines.

Dewsbury.—The T.C. has applied to the B. of T. for an order to construct a tramway from Wakefield Road to Leeds Road.

Japan.—A new electric tramway has lately been completed and put in operation between Shibukawa and the hot springs resort of Ikao, in Joshu.

Kirkcaldy.—A start is expected to be made at once with the new tramway between Kirkcaldy and Dysart. The contractor's plant has arrived. A large staff of men will be employed, and an effort will be made to have the line open for the New Year's traffic.

Lanarkshire.—Considerable dissatisfaction has been expressed by members of the Lanark County Council at the position taken up by the Lanarkshire Tramways Co. in deciding to apply to Parliament for an extension of the time for completing the tramway for a further five years. Mr. Hamilton, Bellshill, said the company had failed them for the past three years. Had it not been for the company they might have had the Glasgow Corporation tramways to Bellshill. As the tramway company is promoting a prov. order, consideration was delayed.

Leagrave.—Messrs. Balfour & Beatty, of London, are applying to the Light Railway Commissioners for an order to construct a light railway from Luton, connecting with the tramway there, to Limbury and Leagrave. Current will be taken from Luton T.C.

Middlesex.—The contract for the Sudbury extension tramway has been completed by Messrs. G. Wimpey & Co. The contract price for the work was £27,132. When the 10 per cent. retention money has been paid, the total amount received by the contractors will be £33,467, or £6,335 over the contract price. This is accounted for by extra works and agreed changes in material which were found to be necessary.

(Continued on page 911.)

THE LATE MR. GUSTAV BYNG.

On Friday last, at Golder's Green Cemetery, were laid to rest, in the presence of a large company of relatives, business associates and staff, and friends, the remains of Mr. Gustav Byng, founder and chairman of the General Electric Co., Ltd., whose death was announced in our last issue.

Mr. Byng has been very actively connected with the electrical industry of this country for considerably more than a quarter of a century, having taken advantage of the opportunity that the beginning of a new industry afforded those who were possessed of courage, faith, and foresight as to its future. It was greatly to be deplored that, though he had lived to see a large measure of success attend his efforts in the upbuilding of a great business, and to share the fruits resulting therefrom, he had for many years suffered from a complaint which gradually undermined his constitution, notwithstanding a brave fight that he made against it. A few years ago his health became too impaired to allow him to take so large a part as formerly in the administration of the affairs of the firm of which, in conjunction with his great friend and co-worker, Mr. Hugo Hirst, he was the founder some 27 years ago; but he continued to take a very deep interest in General Electric affairs, and as chairman he was no mere figure-head. Indeed, almost to the end he was ever ready with his advice, financial genius, and decision in affairs, to aid in the progressive policy of the company and its many subsidiary organisations. We are informed that his gift for finance was not the least potent of the forces which raised the General Electric Co. from very small beginnings to its present important position amongst electrical companies. Mr. Byng, in the midst of his unfortunate affliction, was naturally proud and happy to live to see two of his sons taking an active part in the business. One of these, as we mentioned last week, is a member of the directorate, and, we are pleased to learn, has developed an aptitude in practical organisation and a business acumen that should be of material advantage. A third son who carried off a gold medal at Faraday House, is pursuing a further course of studies at Harvard University, while a fourth son is studying law with a view to joining the firm in another capacity.

Mr. Gustav Byng, M.I.E.E.

The deceased gentleman was born in Bavaria in 1855. He received his education at the Augsburg Polytechnikum, a school of higher general scientific instruction, and coming to this country in 1873, at the early age of 18, he elected to make it his home, and in 1879 he became a naturalised Englishman. It was about this time that he commenced business on his own account as an electrical engineer and a manufacturer of electrical apparatus. There are doubtless still many readers of the Electrical Review who well remember with us how small and primitive a thing the electrical industry then was in comparison with what it has become to-day.

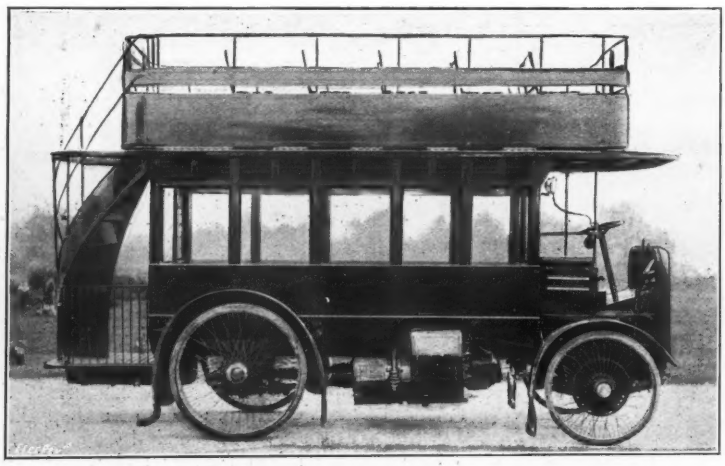
It was an event fraught with important consequences for the history of the business that Mr. Byng found in Mr. Hirst a kindred spirit and co-worker whose administrative talents and technical ability were of the utmost value to him in what was undoubtedly the great work of his life—the building up and constant expansion of the General Electric Co. The works were originally at Manchester, where the cradle, so to speak, of this great industry is still to be seen in the old Peel Works, where the Peel-Connor telephones are now made. But the main works of the company were moved some years ago to Witton, near Birmingham, where 106 acres were purchased as the site of the necessary workshops and other buildings. The late Mr. Byng took the keenest interest in this great work of development and supervised with the greatest care the necessary financial arrangements. At Witton there are now, besides engineering shops for the manufacture of the largest electrical machinery, arc lamp and switchboard shops, electrical carbon and chemical factories, steel and brass tube works, an iron foundry and power house with a capacity of 2,500 H.P. Mess-rooms for the employés, club-houses and workmen's cottages, are also to be found adjoining the works. No fewer than 8,000 people are now employed in the various manufacturing and other establishments of the firm in this country alone, which, in addition to its several works in England, has its branches and agencies in almost every commercial centre throughout the entire world. The General Electric Co. is the parent from which the well-known Robertson Electric Lamps, Ltd., Osram Lamp Co., Peel-Connor Telephone Co., and the other subsidiary companies have sprung. Several of these companies have found a foothold abroad, on the Continent and in the British Colonies. These facts need all to be recorded here, for they form part of the story of the life of a "captain of industry." We are given to understand that Mr. Byng was in his early days an indefatigable inventor, but in his inventing he always had an eye for the practical, commercial result—and, unlike the usual run of inventors, he generally got it. His name is associated with the improvement and development of telephony and electrical signalling, with the advance of electric lighting, heating and cooking, and with the construction and improvement of electric meters.

That Mr. Byng was an ardent tariff reformer our readers do not need to be told, for they will, many of them, remember that in his book on "Protection" he very early put forward his views on this subject. The book, by the way, is said to have even inspired such advocates as Mr. Joseph Chamberlain and Mr. Bonar Law, who have given public acknowledgment of that fact. We are informed that it was largely due to his own efforts that the Tariff Reform League, of whose Council he was a member, was founded. His addresses on this and other business and industrial questions to the shareholders, staff and employés of the company, were always bearing evidence of his zeal in such directions.

Mr. Byng was a strong advocate of combination and co-operation in industry, and as chairman of the Manufac-

turers' Association of Great Britain, had occupied himself with this subject; he was also interested in efforts to deal with industrial legislation and to procure modifications in foreign and colonial tariffs in favour of British manufacturers. He was a member of the Institution of Electrical Engineers and many other technical and public bodies.

In conclusion, it may be added that those who sometimes felt compelled to differ from Mr. Byng always found him one of the most genial of controversialists, whether they exchanged views with him by pen or by tongue.



Exterior of Daimler K.P.L. 'Bus, showing One Power Unit.

THE DAIMLER PETROL-ELECTRIC OMNIBUS.

In June last a new type of petrol-electric 'bus, known as the "Daimler K.P.L." omnibus, owing to its incorporating Knight, Pieper and Lanchester patents, was successfully tried on the road.

The power system adopted incorporates the direct petrol drive, but with the addition of a floating buffer battery, means being provided for storing the excess power of the engine, and, *vice versa*, supplementing the engine power when deficient; apart from this, the constructional features of vehicle are novel, the under-frame and body forming a single steel structure.

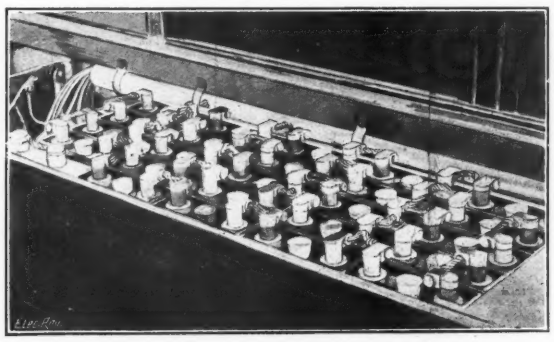
Two distinct power units are used for driving, hung from brackets on either side of the 'bus. These each consist of a 12-H.P. four-cylinder Knight-Daimler engine (7 mm. bore, 114 mm. stroke), coupled direct to a dynamo-motor with a normal rating of 3 KW.; the shaft of the latter is coupled, through a magnetic clutch and brake, and universally-jointed shaft, to a worm drive fitted to each rear wheel through a tubular cardan shaft. No differential gear is required with this arrangement.

The dynamo-motor is a six-pole shunt-wound machine, which converts any excess of power given out by the engine into electrical energy, charging the battery. When a greater torque is required than can be given off by the engine alone, such as when starting, &c., the back E.M.F. of the battery becomes greater than the generator E.M.F., and the battery discharges, aiding the engine by converting the electrical set into a motor. The change from generator to motor, of course, takes place automatically, according to the peculiarities of the road.

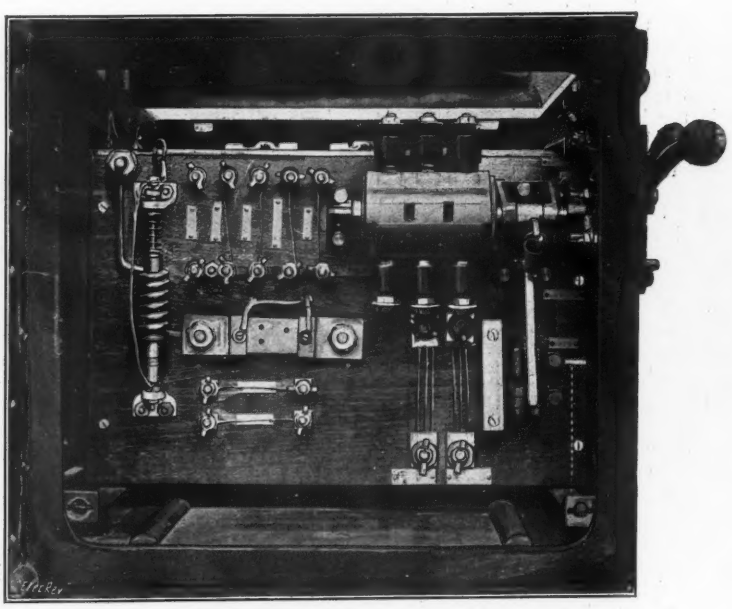
The battery consists of 24 Tudor cells, which, together with a switchboard, are housed under the driver's seat.

For the control of the 'bus, there are two levers placed on the top of the steering wheel; one connected to the dynamo field controller entirely controls the speed, which varies between 3 and 14 miles per hour. The other is used in conjunction with two solenoids operating separate throttles in each engine inlet pipe, and only as a means of controlling the electric governor when required. For running in a forward direction, the two machines are in parallel with the battery. The field regulation is controlled by a common rheostat.

For reversing, the machines are placed in series, and a nice slow running, together with a good torque, is obtained. The parallel-series positions are obtained by a simple controller, the operating lever for which is within easy reach of the driver, but is not touched by him until change of direction is required. The magnetic brakes and clutches on both power units are in parallel with a single controller, operated by a pedal. A careful study of the system of electrical con-

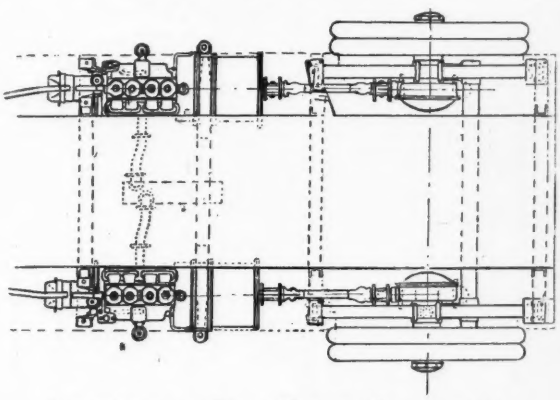


Battery under Driver's Seat.



Switchboard at One End of Driver's Seat.

nections reveals many interesting possibilities in case of failure of any part; for instance, supposing there was a seized piston or broken connecting rod on one engine, the 'bus is by no means disabled, as running can be done on the remaining set, driving on the one wheel only. Again, supposing the ignition of one engine to have entirely failed, due to a magneto breakdown, both sets will keep on driving, the one with broken down ignition acting as a motor only, and the engine of the other doing more work to make up for current taken by the motor from the battery. Under normal conditions the buffer battery is floating, that is, it is neither on charge nor discharge; the amount of



Arrangement of Petrol-Electric Drives on the Daimler 'Bus.

power given off from the engines is regulated by an ingenious solenoid device connected to the throttle, taking the form of a very small electric motor having its field windings in series with the main leads of the dynamo-motor, the armature being shunt wound and permanently earthed. The regulation is caused by the direction of flow of the current passing through the main generators. When a charging current is passing, the throttle motor tends to rotate against a spring-loaded butterfly throttle in the induction pipe, closing it, and when a discharging current is passing, it tends to open up the throttle, thus always keeping the E.M.F. of the generators and battery equal.

The control lever, situated on the top of the steering wheel, allows the driver to adjust the throttle motor to act

Clutch and Brake Control on the Dashboard.

at any given rate of charge to suit the route the vehicles run upon, or to charge the battery rapidly if required.

Another patented device is employed for regulating the magnetic clutch independently of the driver. A solenoid in circuit with the main leads of the generators is adjusted so as to break the clutch circuit at a given battery discharge, and allow, by means of a resistance, a predetermined current to pass through the clutch windings, thus giving the exact amount of slip required to take up the drive evenly without jerk, and preventing more than a fixed rate of discharge from the battery and the possibility of a fuse being blown in traffic.

A radiator placed in front of the 'bus is connected to both engines, a common pump ensuring circulation. This pump is driven by a small ½-H.P. electric motor, which also drives a fan mounted behind the radiator. Independent magneto ignition is provided for each power unit.

The total unladen weight of the 'bus complete, ready for the road, comes out at 3 tons 9 cwt., the regulations under the same conditions allowing 3 tons 10 cwt.

Controller and Gear under Footboard, Daimler K.P.L. 'Bus.

In its various trials, the 'bus has been exceptionally reliable on greasy roads, nothing in the nature of a dangerous side-slip having occurred in some 5,000 miles' driving.

Other valuable features are the ground clearance, some 15 in., and short wheel-base, the latter much facilitating manœuvring in crowded traffic.

In conclusion, our thanks are due to the Daimler Co. for the information and views contained in the foregoing description.

AN ELECTRIC RECORDING TARGET.

Within the last few years the science of rifle shooting has developed at a great rate, not only in this country but abroad.

The high velocity small-bore rifle, and, in this country, the adoption of scientifically-designed aperture sights for a large proportion of the competitive shooting, more particularly by the very numerous miniature or low-power rifle clubs which have sprung into existence during the last few years, have contributed largely towards this result. Naturally, attention has, at the same time, been turned towards the improvement of targets and the introduction of more scientific methods of recording the results of the rifleman's efforts, and in this connection a good many attempts have been made to produce a satisfactory automatic recording target; but until lately the problem of indicating with accuracy the location of a shot hole on a target remained unsolved. However, it is probable that the electric target which was recently shown by Rose's Recording Target Co., Ltd., on the St. Bride's Range, E.C., meets all the practical requirements of such an apparatus, its utility where extremely accurate shooting is concerned, and particularly where the position of each individual hit is a matter of importance, being scarcely a matter of question.

This apparatus consists of an object target, fig. 4, p. 910, which is essentially a long roll of paper (wound from one roller on to another), a square of which is exposed through an

armour plate so as to be shot at and perforated, and then wound up after each shot.

The perforation B passes under a row of contact fingers, fig. 3, one or more of which drops into the hole, and makes contact, immediately disconnecting a clutch C, stopping the mechanism, and indicating on the reproducer, fig. 1, the exact position of the bullet hole.

Fig. 1.—Rose's Reproducer or Indicator Target.

The reproducer consists of a transparent facsimile of the object target; behind it is a permanent magnet milli-amperemeter D, fig. 3, the pointer of which E, has on its tip G, a small white disk representing the bullet hole; this tip comes to rest in a position exactly representing that of the hit on the target.

The movement of the paper on the object target is

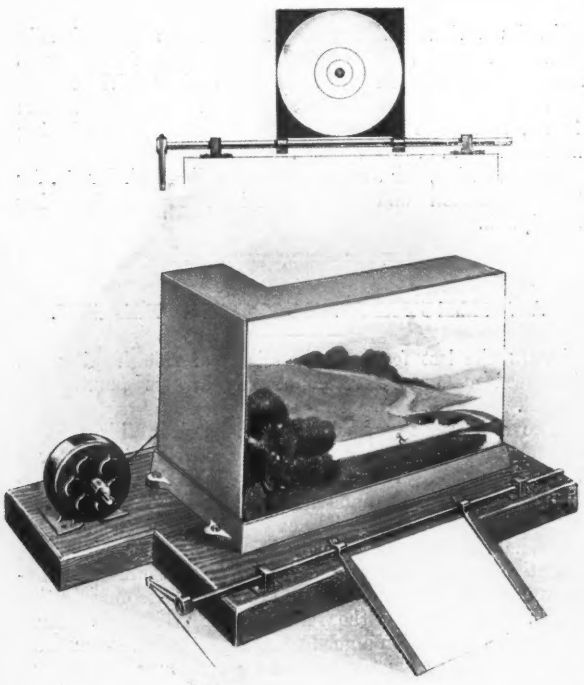


Fig. 2.—Scenic Recording Target for Moving Objects—Stationary Bull's Eye (shown above) Folded Down.

accomplished by a small motor, fig. 2, and on short ranges this movement is mechanically transmitted, on a reduced scale, to the carriage of the pointer in the indicator target, fig. 1, the pointer moving horizontally across the face of the latter a distance corresponding to that of the paper with the bullet hole in it. At the bullet hole the contact fingers on the object target complete the circuit to the milliampere-meter through a small resistance, which varies according to the position of the contact finger, and the pointer moves vertically to the position giving the correct elevation of the bullet hole.

The vertical row of fingers is coupled to a continuous

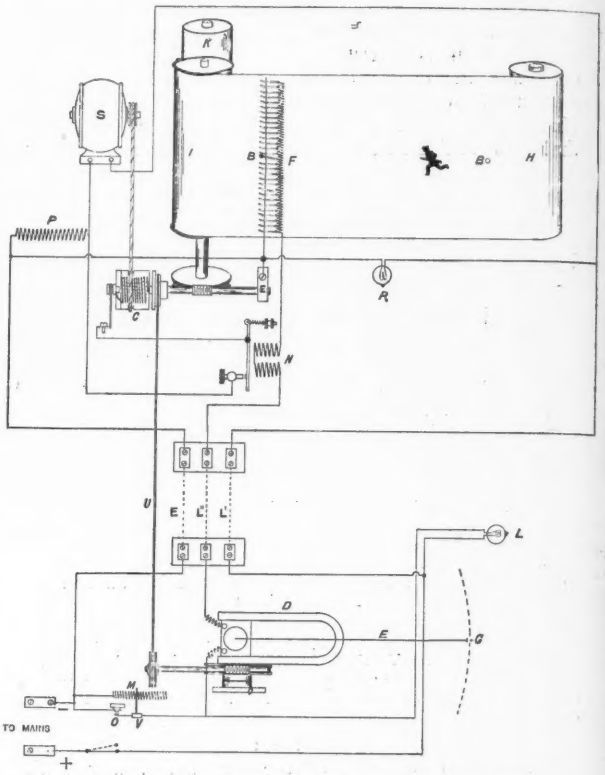


Fig. 3.—Diagram Showing Arrangement of Target Apparatus.

resistance F, each finger being connected to a higher resistance than the one below.

The combination of mechanical horizontal movement with vertical electrical movement gives 200 position indications per square inch of target.

In practice, a dummy bull's eye or figure card is placed in front of the object target, and a transparent copy of this in

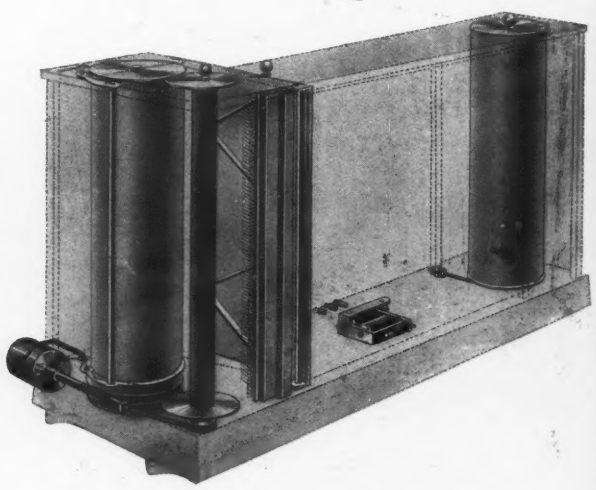


Fig. 4.—Object Target, Showing Paper Rolls, &c., Behind Shield.

front of the reproducer, where the hits are recorded; the object target is then stationary when fired at.

Shooting practice can, however, be made with a running man or deer printed on the object target paper itself, with the latter in motion.

For this class of shooting a scenic target is provided, fig. 2, with an aperture through which the moving man is

seen; a replica of the man is provided on the indicator screen, and it will be obvious that not only the position of "hits," but also of "misses," will be recorded—complete information which the marksman has hitherto been unable to obtain.

Normally the apparatus is at rest, owing to one of the fingers making contact through a perforation or gauge hole. The gauge holes are punched at regular intervals of approximately the width of the target, and so placed that the pointer returns to zero at each one.

The operation of the apparatus can be traced from the diagram, fig. 3, in which the pointer is in the gauge hole, and the current is flowing from the + main through the reproducer illuminating lamp L and the adjustable potentiometer M to earth, and in parallel with this to earth through the contact finger, by way of the reproducer D and the cut-out N, which cuts off the current from the magnetic driving clutch C.

If the short-circuiting key O is pressed, the current is cut off from the cut-out, and the armature returning, establishes the clutch circuit, starting the mechanism, and removing the perforation from under the contact finger, after which the key may be released, and the machine runs (if no shot has been fired) until the next gauge-hole is reached, by which time the reproducer pointer has travelled across its screen, released itself, and returned automatically to zero.

A shot may now be fired, the key depressed momentarily, and the sheet travels on to the bullet-hole, which is indicated as explained. Another depression of the key starts the machine, which runs to the next gauge-hole, the indicator returning to zero ready for the next shot.

It will be seen that actually the horizontal position is given by the distance of the bullet perforation from the gauge hole, regardless of whether the perforation was made whilst the paper was at rest or travelling. To start the apparatus, it is only necessary to put a plug in a lamp socket and switch on. In the diagram, P is a shunt across the clutch coil, R the target lamp, S the motor, H the reserve roll of paper, I the speed roller from which the speed of the paper and reproducer pointer is controlled, K the receiving roller for used paper, E, L′, L′ connecting wires, U the reproducer driving belt, and V a sliding contact maker to adjust the voltage of the reproducer circuit.

It is only necessary to add that the apparatus offers itself to various other developments. For instance, in the case of an important shooting competition, the indicating target can be enlarged so that an audience can see the result of the shooting, and the speed of a moving target can be exactly regulated to suit the desired shooting conditions.

For long-range work, all the movements of the indicator would be obtained electrically, a simple electric ratchet motion actuated from a contact maker giving the horizontal movement of the pointer; and, in such a case, the expense of a marker and his liability to error would also disappear.

The apparatus is really very simple, and its operating cost, for energy and paper, trifling.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 906.)

Manchester.—The Corporation is seeking powers to construct and run tramways through Urmston.

Morley.—At a special meeting of the T.C. last week, it was decided to purchase so much of the undertaking authorised by the Morley and District Light Railways Order, 1901, as is within the borough, and the consent of the B. of T. is to be sought.

Paraguay.—According to the German newspaper published at Buenos Ayres, the A.E.G. has succeeded, after a keen contest, in obtaining from the Congress of Paraguay a concession for the establishment of electric tramways in Ascension and vicinity, and for the erection of a generating station for the tramways and the supply of light and power for industrial purposes. The concessionaire company is authorised to install tramways in those streets in Ascension in which already conceded tracks of the existing tramway company do not exist. The city authorities will not be empowered until after 1921 to grant other concessions for those streets which have by that time not been occupied by the concessionaire company, which is to introduce the overhead trolley system with a line pressure not exceeding 600 volts. The charges for lighting and power consumption amount to 20 centavos gold per KW.-hour. It is stated that the city authorities have been placed under the obligation to receive a supply of current for public lighting at a fixed price, including the maintenance of the lamps. The only tax payable by the holders of the concession is 5 per cent. of the gross receipts to the town, and the former will also be exempt from import duties on the materials for construction and working the undertaking.

Potteries.—A B. of T. inquiry was held at Stoke-on-Trent on November 24th, relative to the application of the Potteries Electric Traction Co. to abandon the construction of the following sections of tramways under the orders obtained in 1897 and 1902:—Newcastle to Trent Vale; Hanley to Bucknall; and from the Meir terminus to Catchem's Corner. It was explained that the earning capacity of the tramways in the district was less than expected, while the expenses were higher than anticipated. The company had exhausted its share capital, and it could not raise money on its debentures. The estimated cost of the lines in question was £43,000, and Mr. Geo. Cornwallis West, chairman of the company, said he could see no possibility of raising that sum. Opposition was offered by the Stoke-on-Trent and Newcastle T.C.s, the Stone R.D.C., and on behalf of the Duke of Sutherland.

Rochdale.—The Electricity Committee has decided not to proceed with the construction of the line from Shawforth to Bacup until the weather is more favourable. Discussion took place on the question of the price of electricity for traction purposes, and the feeling was that, as the Tramway Committee is such a big customer for current, the Electricity Committee should agree to a readjustment of prices.

Rotherham.—A company is being formed to construct and work electric trolley 'buses between Rotherham and Dinnington *via* Wickersley, Bramley, Laughton, Maltby, Morthern and Brampton.

Scarborough.—The directors of the Central Tramway Co., Scarborough—a cliff tramway from St. Nicholas Cliff to the sands—have installed an electric motor and fittings instead of renewing the old steam boilers, which were worn out.

South Lancashire.—Notices were issued the other day by the South Lancashire Tramway Co., intimating its intention of seeking Parliamentary powers for the construction of additional tramways in Little Hulton township, which will join up with the existing system near the power station at Walkden.

TELEGRAPH and TELEPHONE NOTES.

Cable Repair.—The cable steamer *Alert* has been anchored off Yarmouth (I. of W.) during the past week in order to repair the cable between the Needles and Hurst Castle. The fault in the cable was in close proximity to the Needles Rocks, and the work was difficult to perform. Owing to continual chafing of the cable on the rocks, it had become worn through. It was not possible for the cable steamer to approach the rocks, so small boats had to be brought into use.

Glasgow.—There has been correspondence between the town clerk and the Postmaster-General as to intercommunication between the subscribers of the former Corporation telephone system and the subscribers of the National Telephone Co., and as to the rates charged by the Post Office for a limited telephone service and over a limited area as compared with the Corporation rate and area. A letter has been received from the Postmaster-General stating that arrangements are in progress by which subscribers of the former Corporation telephone system will be able, after January 1st, to communicate with subscribers of the National Telephone Co. on payment of a fee of 1d. per call. As to the rate of charges to new subscribers, the Postmaster-General does not think these too high. The T.C.'s Special Committee still holds that the rates for measured service are unnecessarily high, and a sub-Committee has been appointed to confer with other Corporations and bodies interested and to approach the Postmaster-General later.

Wireless Telegraphy.—In his annual report to the Secretary of War, Brig.-Gen. James Allen, chief signal officer of the United States Army, takes issue with the operating commercial wireless telegraph companies that claim to have efficient interference preventers, and, deploring the confusion which he states exists everywhere in the transmission of Government messages, urges that measures be taken at once to secure Government control of wireless telegraphy, both in peace and war. Referring to the Berlin international agreement of 1906, he says:—

"As the United States up to this time has not given its adherence to the convention, ships flying the American flag find themselves without standing in international wireless telegraph circles, as none of the contracting countries is compelled to receive a telegram from a vessel of a non-contracting nation, and any coastal station in a foreign country may refuse to transmit a message to a station on shipboard which is subject to a non-contracting nation.

"Owing to the absence of definite regulations, there is great confusion in the transmission of wireless messages on the coast of

the United States, which interferes very materially with wireless communication between the various sea-coast defences and with our ships at sea. The army now has 15 wireless stations on shore, located at various points in the United States and Alaska."—*Electrical World.*

Apparatus designed by Mr. Thorne Baker is to be used by Lieut. Watkins in his all-British aeroplane flight across the Channel, in the endeavour to maintain communication with a launch which will accompany the aeroplane. The apparatus has been made by the Marconi Co. in co-operation with the inventor.

An order has been issued by the Austrian Minister of Commerce, providing that Austrian passenger ships whose service extends beyond Gibraltar or Aden must be fitted with wireless telegraph apparatus.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 4th, 1911. Three multiple switchboards, for the P.M.G.'s Department in New South Wales. See "Official Notices" November 4th.

December 2nd and 13th.—(*a*) Six single-phase transformers; (*b*) bare hard-drawn copper cable, for the Melbourne City Council. See "Official Notices" November 25th.

December 29th.—(*a*) Telephone cable, (*b*) battery and line material and instruments, for the P.M.G.'s Department in South Australia. See two "Official Notices" November 4th.

January 4th, 1911.—Iron poles, ironwork, and switchboards, for the P.M.G.'s Department in Queensland. See "Official Notices" November 18th.

January 10th, 1911.—Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 10th, 1911.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th, 1911.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

January 25th, 1911.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" to-day.

January 25th, 1911.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" to-day.

SYDNEY.—February 6th, 1911. Arc lamp carbons, for the Corporation Electricity Department. Specifications, City Electrical Engineer, Queen Victoria Markets, Sydney.—*Australian Mining Standard.*

MELBOURNE.—February 22nd, 1911. 2,000 steel tramway plates. Specification, conditions, &c., at the City Surveyor's office, Town Hall.

PERTH.—April 18th, 1911. According to the *Australian Mining Standard*, tenders are invited for one common-battery switchboard for the Perth Central Exchange, consisting of two junction, seven subscribers', four end, two cable turning and two cable storing sections, together with all necessary frame racks, power plant, and all associated apparatus, as per Specification No. 353 and Schedule No. 85. Specifications, &c., at the office of the High Commissioner, London.

Barking.—December 20th. 400-KW. Diesel engine and dynamo, 250-KW. motor-generator, traction battery and reversible booster, main switchboard and connections, and overhead travelling crane, for the U.D.C. Specification from Mr. Henley L. Howard, engineer (deposit two guineas).

Belgium.—December 22nd. The municipal authorities of Theux are inviting tenders for the concession for the establishment of a central generating station in the town for the supply of electricity for private and public lighting and power purposes.

La Société du Canal et des Installations Maritimes, of Brussels (59, Rue du Canal), is about to invite tenders for the supply and erection of three electric travelling cranes.

Birmingham.—December 12th. Sixty electric tramway cars and 400 tramway poles, for the T.C.; Tramway Offices, 147, Corporation Street (returnable deposit £2 in case of cars).

Canada.—December 22nd. Calgary (Alberta) City Commissioners want tenders for a 1,500-H.P. synchronous motor-generator, motor-generator exciter set, switchboard, &c. Specification to be seen at the C.I. Branch of the Board of Trade in London.

East Ham.—Tenders are to be invited for new condensing plant and extensions to the generating plant at the generating station, subject to L.G.B. sanction.

France.—The Chamber of Commerce of Marseilles is about to invite tenders for the supply and erection at the Pinede Dock at that port of 10 electric travelling cranes—five of 4-ton lifting capacity and five of 1½-ton.

Limerick.—December 12th. Wiring and fittings for lighting, bells and telephones, at the new Borough Technical Schools, Military Road. See "Official Notices" to-day.

London.—L.C.C.—December 6th. Ash-dust removing plant, for the East Greenwich generating station. See "Official Notices" October 28th.

December 6th.—Overhead electrical equipment for tramways between Putney Bridge and Wandsworth High Street. See "Official Notices" November 11th.

ISLINGTON.—January 12th, 1911. High-tension switchboard for the Borough Council Electricity Works. See "Official Notices" November 25th.

New Zealand.—INVERCARGILL.—January 9th, 1911. Power-house plant, cars, rails, overhead material, wires and cables, poles, &c., for an electric trolley system, also street-lighting plant for the Corporation. See "Official Notices" October 14th.

TAIHAPE.—January 11th. Hydro-electric lighting and pumping plant for the B.C. Specification can be seen at C.I. Department of the Board of Trade in London.

AKAROA.—One 30-KW. Pelton wheel and generator set, for the B.C. See "Official Notices" November 25th.

Rotherham.—December 13th. High-tension feeder and rotary converters, transformer and switchgear, for the Corporation. See "Official Notices" November 25th.

Roumania.—December 31st. Electric lighting for the City of Botoschan for the municipal authorities. Deposit, £2,610. Herr Bürgermeister, Botoschan. Competency certificates to be lodged by December 21st.

Trimdon Grange (co. Durham).—December 10th. Electrical fittings for a year, for Walter Scott, Ltd., Trimdon Grange Colliery, co. Durham; the Storekeeper.

Turkey.—December 28th. The date for the receipt of tenders for electric tramways in Constantinople and suburbs has been extended from November 10th to December 28th.

The Jerusalem lighting and tramway tenders may be sent either to the Corporation at Jerusalem or to the Ministry of Public Works, Constantinople.

CLOSED.

Australia.—According to the *Australian Mining Standard*, an order has been placed with the British Insulated and Helsby Cables, Ltd., for 20-core lead-covered impregnated paper-insulated copper cable (£176 per mile), for Victoria; and with Messrs. R. Johnson, Clapham & Morris, Ltd., for hard-drawn copper wire, at £69 5s. 4d. per ton.

The P.M.G.'s Department, New South Wales, has ordered from the Western Electric Co. (Australia), Ltd., eight sections of common-battery switchboard, with associated parts, for the telephone exchange, G.P.O., Sydney, at £9,577.

Birmingham.—The T.C. has accepted the tender of Messrs. Griffiths & Co. for the reconstruction of the track of the Bristol Road tramways.

Bolton.—The Guardians have accepted the following tenders:—

Townson & Chadwick.—Electric wiring, new stores, &c., £71.
T. A. Locke.—Electric wiring, Nurses' Home extension, £20.

Cape Town.—The following tenders were received by the architects, Messrs. MacGillivray & Grant, for the wiring of the new building of the Salesian Institute, Cape Town:—

		Insulated conduit.	Simplex.
L. J. Weller	(accepted)	£285	£205
Woods, Monahan & Co.		360	289
Clyde Engineering Works		410	300
Koch & Dixie		412	299
E. A. Shaw & Co.		437	337

Croydon.—The T.C. has accepted the tender of Messrs. Ferranti, Ltd., for meters until March 31st, 1912.

Heckmondwike.—The U.D.C. has provisionally accepted the tender of Messrs. Edward Deane & Beale, Ltd., of London, for condensing plant, at £2,668.

Kendal.—The tender of Messrs. G. Gilkes & Co., amounting to £94, for lighting St. George's Church with electricity, has been accepted.

Lancaster.—Messrs. S. J. Waring & Sons have placed the contract for six 25-H.P. motors for their Lancaster works with Messrs. Horace Green & Co., of Cononley, along with one each 15-H.P., 10-H.P. and 5-H.P. motors.

Leyton.—The U.D.C. has placed orders with Messrs. Venner & Co. for 20 tramcar meters; and with Messrs. Johnson and Phillips, Ltd., for carbons for flame arc lamps, at £5 1s. per thousand pairs for 50,000 pairs.

London.—L.C.C.—The Fire Brigade Committee received the following tenders for the electric lighting of the fire station in Parnell Road, Bow:—

Tilley Bros.	(recommended)	£167
Johnson & Phillips, Ltd.		190
Malcolm & Allan, Ltd.		198
W. J. Fryer & Co.		234

The Stores and Contracts Committee has ordered an electrically driven cross-cut bench-saw and dynamo, for the furniture stores at Clerkenwell Close, from Messrs. J. Pickles & Sons, at £53.

The tender of Messrs. F. Troy & Co. (£615) for the electric lighting of the Hoxton school buildings having been withdrawn, the Education Committee recommends that of Messrs. Tilley Bros., at £738, for acceptance.

MARYLEBONE.—The B.C. has accepted the tender of the Tudor Co. for the supply of a storage battery, at £2,795, with a maintenance contract for 20 years at £220 per annum.

Norwich.—The T.C. has accepted the tender of the Chain Belt Engineering Co., of Derby, for a coal elevator for the electricity works, at £88.

Rugby.—The U.D.C. has accepted the tender of Messrs. Manlove, Alliott & Co., Ltd., for an additional cell for the refuse destructor, at £412.

Sunderland.—The Corporation has placed a repeat order with Messrs. E. Bennis & Co., Ltd., for two "Bennis" stokers and self-cleaning compressed-air furnaces, for the electricity works.

Wallasey.—The tender of the Premier Accumulator Co., Ltd., for the supply of booster and accumulator has been accepted by the Corporation Electricity Committee.

FORTHCOMING EVENTS.

Royal Society of Arts.—Monday, December 5th. At 8 p.m. Cantor lecture on "Industrial Pyrometry," by Mr. C. R. Darling. (Lecture III.)
Wednesday, December 7th. At 8 p.m. Paper on "The Panama Canal in 1910," by Mr. V. Cornish.

Institution of Post Office Electrical Engineers (North-Western Centre).—Monday, December 5th. Paper on "Unit Maintenance Cost System," by Mr. R. J. S. Gold.
(Ireland Centre).—Wednesday, December 7th. Paper on "Unit Maintenance Cost System," by Mr. R. J. S. Gold.
(North Wales Centre).—Thursday, December 8th. Paper on "Unit Maintenance Cost System," by Mr. R. J. S. Gold.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, December 6th. At 7.30 p.m. At the University, Manchester. Paper on "The Methods of Braking in Electric Winding Engines," by Dr. E. W. Rosenberg.

The Committee for the Protection of Electrical Interests.—Wednesday, December 7th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. General meeting (open to anyone interested in the electrical industry) to discuss the advisability of electric lighting undertakers being empowered to wire premises and supply apparatus. Informal dinner at Gatti's Restaurant, Strand, at 6.45 p.m., 3s. 6d. Intending diners or speakers are asked to notify Mr. R. Borlase Matthews, hon. sec., Bank Buildings, Kingsway, W.C.

Institution of Civil Engineers.—Wednesday, December 7th. Students' visit to the new G.P.O. (King Edward VII Building), Newgate Street, E.C.

Association of Engineers-in-Charge.—Wednesday, December 7th. At 8 p.m. At St. Bride's Institute, E.C. Paper on "Practical Notes on the Working and Control of Steam Boilers," by Mr. J. B. C. Kershaw.

Institution of Electrical Engineers (Yorkshire Local Section).—Wednesday, December 7th. At 7 p.m. At the University, Sheffield. Address on "The Cost of Cooking and Heating by Electricity," by Mr. A. J. Cridge.

Institution of Electrical Engineers (London).—Thursday, December 8th. At 8 p.m. At the Institution Building, Embankment, W.C. Paper on "The Magnetic Properties of Iron and its Alloys in Intense Magnetic Fields," by Sir R. Hadfield and Prof. B. Hopkinson. Special meeting to follow at 9.30 p.m.
POSTPONEMENT OF ANNUAL DINNER.—On account of the General Election, the annual dinner of the Institution (originally fixed for Tuesday, December 6th) has been postponed to Thursday, February 2nd, 1911.

Rugby Engineering Society.—Thursday, December 8th. At 8 p.m. At Benn Buildings, Rugby. Lecture on "Electricity in the Himalaya," by Mr. B. F. McMurtrie.

Illuminating Engineering Society.—Friday, December 9th. At 8 p.m. At the Royal Society of Arts. Paper on "Recent Progress in Electric Lighting," by Prof. E. W. Marchant.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued :—

Commanding Officer—COL. H. M. LEAF.

Monday, December 5th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, December 6th.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, December 8th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, December 9th.—"D" Company. Technical drill, 7 to 10 p.m.
Saturday, December 10th.—Week-end run at Sheerness. Parade at Victoria Station, S.E. & C. Rly., 1.10 p.m. and 4 p.m. (See November Regimental Orders.)

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

National Electrical Manufacturers' Association (Inc.).—A special general meeting of this Association will be held at Balfour House, Finsbury Pavement, E.C., on Tuesday, December 13th, at 2.30 p.m., for the purpose of passing the new articles of association. A meeting of the Committee will follow.

University College, London.—An appeal is being made with the object of raising a sum of £15,000 before Christmas Day, in order to secure an important site in Gower Place for the erection of new chemical laboratories. Donations should be sent to the President of the Appeal Committee at University College.

NOTES.

Fees for Electric Lighting Orders.—In the Parliamentary Papers, Mr. Hackett recently put a question with reference to the application of the Templemore Urban Council for an Electric Lighting Provisional Order, for which it remitted the fee of £50. He asked if the fee would be returned, and, if not, under what authority the Board of Trade retained the money. Mr. Buxton said, in reply, that the application was refused by the Board of Trade, as after consideration of the scheme the Board were not satisfied that the powers, if granted, could be exercised without involving the District Council in considerable loss. The fee was a general one to cover the ordinary expenses of the Board of Trade in dealing with applications under the Electric Lighting Acts. Had a local inquiry been necessary, a further fee might have been required. The fee was charged under the authority of the Electric Lighting Acts, and in no case had the Board of Trade returned a fee or any portion thereof.

Charity Ball.—The fifty-fifth annual ball of the Royal Metal Trades' Pension Society is to be held on February 2nd, at the Portman Rooms, Baker Street; Mr. F. A. B. Lord (Messrs. W. F. Dennis & Co.) has accepted the office of chairman, and solicits contributions to the funds of the Society. Tickets (10s. 6d. inclusive) can be obtained from the secretary, Mr. T. Hodges Papworth.

Long-Distance Transmission in Italy.—The development of hydro-electric works in Italy, to which reference was recently made in this journal, was at first almost exclusively carried out in connection with low-pressure installations in the low-level tracts of country in the neighbourhood of the centres of consumption, and was subsequently extended to high-pressure installations in the mountainous districts where the quantity of water is small and the fall very considerable. As the first imported works of the latter kind, a Milan correspondent of a German newspaper mentions the Brusio works in the Puschlav, belonging to the Società Lombarda. The high-pressure line from Campocologno to Lomazzo (between Milan and Como) traversed a distance of 112 miles, and involved an outlay of £320,000, or £20 per KW. available at the place of consumption, so that the line cost one-half of the average cost of £40 per KW. reckoned for hydro-electric works (concession, waterworks, turbines, electrical machinery, conductors, &c.) in Italy. Other long transmission lines have been installed since the Brusio works commenced in 1906. The Società di Elettrochimica has a line 112 miles long from Bolognano in the Abruzzi to Naples, and the Adamello Co. has a line from the High Alps to the foot of the Apennines in the district of Parma, the length being 136 miles. The pressures used on these two lines are 88,000 volts and 72,000 volts, which were, until recently, the highest in Europe; in addition to being able to use a smaller cross-section of copper and having smaller losses in transmission, it is not necessary to have so many supporting masts, the distances separating which have gradually grown from 200 ft. in 1899 to 600 ft. in the case of the Adamello line. These installations have only been in operation for a short time. The development of the high-pressure (water) installations is being accompanied in general by the establishment of storage reservoirs, owing to the great fluctuations in the supply of water and to the natural reservoirs formed by the mountain lakes. The reservoirs assure a sufficiency of water power throughout the winter. A large number of noteworthy reservoirs is reported to be in course of construction in various parts of Italy.

Electric Smelting of Nickel Ore.—A new development of electric furnace methods is now being carried out in the Southern States of America by the Consolidated Nickel Co., at Webster, Jackson County, N.C., and is of interest on account of the refractory nature of the ores operated upon. The nickel deposits in the neighbourhood of Webster consist essentially of hydrated nickel-magnesium silicates, and contain on an average 2 per cent. of metallic nickel. Numerous attempts have been made to work them up into a marketable product by the usual leaching methods, but these have all been abandoned on account of excessive cost. It has now been discovered that the raw product can be easily reduced to nickel silicide in the electric furnace, and in this form the metal is put on the market for the production of nickel steels. The furnace used consists of a steel shell, $\frac{3}{8}$ in. thick, 6 ft. in diameter and 5 ft. high. This is bolted on to a $\frac{3}{4}$-in. base plate, which is connected to one pole of the electric circuit. Iron rods are cast into the base-plate, and around these carbon is rammed to form a hearth. The furnace walls are lined with firebrick, the inside diameter being thereby reduced to 4 ft. The other electrode consists of carbon blocks fitting through the cap of the furnace. At present the capacity of the power plant is 1,000 KW., generated entirely by steam, using wood for fuel. The generators have six poles, and are wound to deliver a normal current of 6,800 amperes at a pressure of 50 volts. They are guaranteed to maintain an overload of 100 per cent. for two hours, and 150 per cent. for 10 seconds without undue heating. The main circuit-breaker in the furnace switchboard is the largest ever made in the United States, and the switchboard panel itself is made of slate 4 in. thick. Electrical energy will, however, ultimately be derived from the Tuckasiye River, which has a fall of 10 ft. per mile, and is capable of yielding 6,000 H.P. The process as in operation at present consists of reducing the crushed ore by means of 10 per cent. of coke. The molten metal and slag are tapped into large slag-pots, when a clean separation of the nickel alloy takes place. The product contains from 10 to 30 per cent. of nickel, 20 to 30 per cent. of silicon, 40 to 50 per cent. of iron, 5 to 10 per cent. of aluminium, 3 to 5 per cent.

of chromium and 3 to 4 per cent. of other metals. It is put on the market at 5d. per lb. upwards, according to the nickel content. The company is in the hands of New York capitalists, who have acquired the mineral rights of 770 acres of land half a mile from Webster. The operation is not to end with the production of this nickel alloy, but when fully equipped the metal will be bessemerised and converted into pure nickel.

Generators for Electro-Metallurgy.—The steadily increasing demand for low-voltage generators has had a stimulating effect on the development of this class of generator. The chief considerations in the design of these machines, especially those of very large ampere capacity, centre upon the following points: The temperature rise above normal is strictly limited to about 60° F. For this reason all parts of the machine are well ventilated, and all conductors worked at low current density. Special care has to be taken to eliminate all heating of current-carrying contacts, as frequent changes of load tend to loosen them. For this reason all parts must be made easily accessible for inspection. Furthermore, the insulation is best preserved in a machine continually in service. Sparkless commutation of the large currents is essential, and satisfactory working depends upon the electrical design as well as upon the construction of the commutator and brushes. The commutators contain a large number of segments in order to reduce local currents. The armature circuits are perfectly symmetrical and equalised with mechanical precision. This is essential on account of the low resistance of the armature winding, slight irregularity leading to the unbalancing of the armature circuits. The current is conducted to the terminal boards by means of brushes making contact with the holders through a large surface. Standard machines are furnished as compound-wound generators, and the compounding is adjusted so as to maintain a constant voltage within the guaranteed rating. Machines up to the largest ampere capacity, and above five volts at the terminals, are self-excited.

Electricity Supply in Berlin.—The subject of the municipalisation of the supply of electricity in Berlin was raised at the recent meeting of the Berlin Electricity Works Co., when the question was asked why the quotation for the company's shares should be lower than in former years, having regard to the favourable situation of the undertaking. In reply, Herr Rathenau stated that the low price was connected with apprehension as to the taking over of the enterprise by the city authorities. He himself had formerly shared that fear, and had regarded the period from 1913—when notice could be given—to 1915, as critical for the company. He was, however, of opinion that the city would not acquire the undertaking, as the large sum of £5,000,000 would be required for the purpose, and as it would probably be thought better to continue to receive a share in the profits than to absorb the works, which had already yielded to the city about £2,000,000. Apart from this circumstance, the directors had no apprehensions concerning the future of the company, as they had invested one-third of the share capital in the Electricity Supply Co., and good and useful extensions would always be kept in mind.

King's College Engineering Society.—The seventeenth annual dinner of the students and professors of this College was held on Saturday at the Trocadero Restaurant, Regent Street. Mr. Alexander Siemens occupied the chair, and there was a good attendance, the guest of the evening being Prof. Silvanus P. Thompson. Mr. J. M. Knight gave the toast of "Our Guests," which was responded to by Prof. Thompson. He remarked that he had known various men who had passed through the college with great *éclat*, and among them was his dear friend John Hopkinson, whose memory would always remain associated with King's College and its engineering faculty. Addressing the students, the Professor said there was something more than merely getting on or making a name and a place in their profession, and that something more was in getting out of life that which they could not get if they merely thought of its material end and its material gains. After all, there was something far greater in life than the mere things by which they made their bread and butter; and in this utilitarian age those side issues, those mental and intellectual recreations, were too often neglected. Men who were in association with a great college like King's had many opportunities and chances which others who were training for the engineering profession did not enjoy. When they came to think of it, they were too apt, in an engineering career to find the refinements of life and intellect crowded out; but by being trained in that college they preserved the taste for those higher things, and avoided making their profession simply a thing to make money and fame.—Mr. A. P. Williams next proposed "The College and Staff," which was responded to by Prof. J. M. Thomson, who humorously remarked that the staff endeavoured to do their duties as well as they could, although individually they were thoroughly aware of the faults of their colleagues. During the time he had been connected with the institution he had seen many changes in both the college and the staff; but there was one change he had never seen—that was any diminution in the sympathy which had always existed between the staff and the students. There was that curious reciprocity between the staff and the students, without which no educational institution could be a success. He wished to assure them, speaking for the staff, that he was perfectly certain that as long as that reciprocity existed the students might be assured that the staff would always be in sympathy with them, and would always wish them well in their future careers.—The chairman, in giving the toast of "The Engineering Society," said he believed it was originally founded in 1840, and, after flourishing for some time, it was turned into a Shakespearian Society, and eventua was again transformed into an Engineering Society. The real difference between civilisation nowadays and the civilisation of the old kingdoms had been brought about by the work of the engineer. Therefore, all who aspired to become members of that profession ought to be conscious of the fact that they were the real civilisers of the world. Whatever was done nowadays in literature and art had all been done before, but only since engineers had improved the means of communication, and substituted electrical power for hand labour, had the present civilisation become possible. Nowadays the mechanical life was getting more and more complicated, and it was more and more necessary to co-operate to bring about further progress, and an engineering society was the proper means of promoting that co-operation. The more they got to know one another the more accustomed would they become to look upon their competitors as friends, and not necessarily as foes, and by judicious co-operation they would see that they would be able to get forward much better than if everybody was trying to stand on his own, and to keep everything to himself. The society was fulfilling a very useful purpose, and he wished it continued prosperity. The toast was replied to by Mr. G. H. Alabaster, who said that the society was as flourishing now as it had ever been. He would like to see a little more interest taken in the visits, as they afforded a very excellent opportunity for the students to see put in practice the theories which the professors put forward in their class rooms. He was pleased to say that they had a record number of papers this year, and if only the high average of past years was kept up, they would have every reason to feel proud of the literary capabilities of their members.—The health of the chairman was heartily drunk on the proposition of Mr. M. K. Ingoldby.

The I.E.E. Dinner Postponed.—On account of the General Election, the Annual Dinner of the Institution of Electrical Engineers (originally fixed for December 6th) has been postponed to Thursday, February 2nd, 1911.

Electric Time Service.—A scheme for a "municipal time service," by which about 100 clocks will be electrically controlled by a "master" clock at the Town Hall, is under the consideration of the Blackpool Town Council.

Inquiries.—A correspondent wishes to be put in communication with a manufacturer of renewable-rimmed gear wheels for tramcars. The makers of "Cornite" are asked for. A correspondent wants a receipe for a waterproof ink (any colour) that will not wash off glass.

Consular Notes.—Japan.—The British-Consul at Kobe reports that in spite of the fact that the imports under the heading of machinery have decreased 46 per cent., or over £670,000, it is a little consoling to find that in the returns for electrical machinery the proportion of British to German and American imports has largely improved. British electrical machinery is much esteemed by the Japanese, but the merchant has always the same difficulty to contend with, viz., that cheapness is likely to outweigh considerations of quality in the estimation of the Japanese. In machinery of other kinds there has been a great diminution of importations as noted above, due principally to the general depression in business throughout the country. Many new electric light and tramway companies were started during 1909, to which cause the increase in the imports of electrical machinery is to be attributed, but the boom in that line came to an end with the close of the year. Apparatus and machinery for gasworks have been imported from the United Kingdom to a very large extent, but it is not likely that this extensive importation will be maintained for more than a few years more, a great deal of the plant required for such undertakings being now manufactured locally. As in other lines, the general tendency is to penalise the foreign imports by heavy duties and to foster the home industries. Machine tools are now being turned out in ever-increasing quantities by Japanese engineers, which presumably satisfy their requirements, although the foreign importer is of the opinion that they are unsatisfactory. They are cheap, however, and experience will show which can command the market. The boom in electric light companies increased the demand for British-made electrical wires and cables, which are much preferred to those made in other countries, but once more the preference for cheapness before quality prevents larger sales. There are now many small cable manufacturing concerns working in Japan. Only one of these concerns, however, competes in quality with the imported goods. This factory is equipped with British machinery, and has the services of a British cable expert.

The British Consul at Osaka reports that considerable progress has been made during the year with the extension of the municipally-owned electric railway. With the main object of carrying out the proposed extensions of the system, a loan of over £3,000,000 was floated by the city authorities on the London market at the end of May, 1909; and upon the successful issue of the negotiations, work on the third section (32 miles) of the system was at once commenced. During the year the length of line (double track) opened to traffic was 2·3 miles, and a further two miles was to be open early in 1910. The work as it proceeds involves the widening of streets and the building of new bridges, and in one part of the city an embankment has been built for a distance of about a mile along one of the principal rivers, the completion of which work has brought about a further great improvement in the aspect of the city. The receipts during the year amounted to £125,265, and the working expenses to £42,673. The amount expended in construction work since August, 1908, to the end of 1909 (that is to say, on the third section of the line), was £81,146. This sum includes, of course, the amount paid by way of compensation for, or the purchase of,

land that has been occupied. Within three months of the beginning of 1910, two new electric railways were to be opened to traffic. The first of these connects Osaka with Kyoto, and has a total length of 29½ miles. The other runs from Osaka to Takaradzuka, a summer resort about 16 miles from Osaka. The latter line is subsequently to be extended from Takaradzuka to Arima, and also to Nishinomiya, a town of considerable size on the coast halfway between Kobe and Osaka. A further extension from Nashinomiya to Kobe is also contemplated. Both these lines traverse prosperous districts, and should be profitable investments, though both will, to a certain extent, compete with the Government railway lines; the former with the Tokendo line between Osaka and Kyoto, and the latter with the southern portion of the Hankaku line from Osaka to the naval port of Maizuru on the north coast of the island. The machinery for the Kyoto line, &c., with the exception of the bodies of the cars, which were made by the Kawasaki dockyard in Kobe, was all supplied by a British firm. The order for the plant for the Arima line was secured by an American company. It is probable that the two lines above mentioned will shortly be linked up with the City Electric Railway and also with the Hanshin Electric Railway, which has been running for the last five years between Osaka and Kobe. In addition to these lines shortly to be opened, there have been, since the commencement of the year, 1909 numerous schemes brought forward for the construction of electric railways to various places in the neighbourhood, including one to Nara—a town of about 45,000 inhabitants, 25 miles east of Osaka—another line to Kyoto, on the opposite side of the Government railway to the line just completed, a line for an express train service between Osaka and Kobe, and many others. The only one, however, for which a charter had been obtained is a line to Sakai, a prosperous city six miles to the south. This line will run parallel to the Nankai railway to Wakayama, which had already been electrified as far as Hamadera (four miles beyond Sakai), and is shortly to be electrified for the whole length of 40 miles. The other tramway schemes, however, are hardly likely to mature, at any rate for several years.

Institution and Lecture Notes.—Liverpool Engineering Society.—On Wednesday a paper on "The Control of Fuel Supplies" was read by Mr. J. B. C. Kershaw, F.I.C., in which, after referring to his paper of 1903 before the same Society, supporting the purchase of fuel on chemical and calorific tests, the author described how the methods advocated had been put into practice, and discussed the most useful methods of testing fuel. He used the Darling calorimeter, standardised with the Mahler-Donkin Bomb calorimeter, and improved in various details. Mr. Kershaw considered that in every case where 20 tons or more of fuel was consumed per week there was a chance of saving money by regular sampling and testing. The opposition to scientific methods came from some colliery-owners, who objected to the deterioration in the quality of the fuel being revealed by testing.

Institution of Electrical Engineers (Yorkshire Local Section.)—A reception by the chairman (Mr. T. Harding Churton) and smoking concert is to take place at the Hotel Metropole, Leeds, on December 13th (7.45).

Devonport Dockyard Electrical Fitters' Association.—An interesting lecture on "Telephones" was delivered on November 10th, by Mr. P. J. Watts, assistant electrical engineer, of Devonport Dockyard.

Institution of Electrical Engineers (Glasgow Section).—It has been decided to contribute 20 guineas from surplus funds towards the erection of a memorial in the grounds of Glasgow University to the late Lord Kelvin, the first President of the Section.

The Institution of Electrical Engineers.—A special general meeting of members, associate members and associates is to be held in the Lecture Theatre of the Institution on Thursday next, December 8th, at 9.30 p.m., for the purpose of considering, and, if approved, of passing the following resolution:—"That the action of the Council in borrowing (under the powers given to them by the members, associate members and associates assembled in special general meeting on June 30th, 1908) the sum of £11,500 from the Economic Life Assurance Society on the security of the freehold and leasehold property of the Institution, being Nos. 15, 16, 17 and 18, Tothill Street, Westminster, on the terms of the indenture of mortgage dated July 15th, 1910, a copy of which is now produced at the meeting, be and is hereby authorised and confirmed."

Birmingham Hospital Electrical Department.—On November 24th Mr. W. A. Cadbury formally opened the new electrical department which has been constructed at the Birmingham and Midland Hospital for Skin and Urinary Diseases. An electric plant for the treatment of lupus, cancer, and other skin diseases was first installed at the hospital nine years ago, but owing to the growth in the importance of the department and the increasing number of patients treated, it has been found necessary from time to time to enlarge the accommodation provided for this branch of the institution's work. A new and well-equipped department has been constructed in the basement of the building at a cost of £2,000.

Royal Assent.—On November 28th the Royal Assent was given to the Loch Leven Water Power (Transfer) Order Confirmation Act, 1910, and the London Electric Supply Act, 1910.

Appointment Vacant.—Junior assistant engineer in the business development department of the Birmingham electricity department (£100). See our advertisement pages in this issue.

Lamps for Sale.—The Metropolitan Asylums Board are advertising 2,000 carbon-filament lamps (200 volts) for sale. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Stepney B.C. General Purposes Committee has been considering the salaries of five members of the electricity department commercial staff and a grade of classification. It is recommended that Mr. A. J. Squire, chief clerk, should be advanced in August next to £250, and thence by £10 per annum to £300; Mr. E. E. Dorking, senior analysis and prime cost clerk, £160 (advancing by £10 per annum to £180); Mr. E. E. Pepper, senior consumers' clerk, £150 (rising to £180 by £10 per annum); Mr. T. J. Archer, senior correspondence clerk, to be technical correspondence clerk, £150 (rising by £10 per annum to £180); Mr. E. W. Simmons, assistant analysis and prime cost clerk, to £140, rising to £150.

A smoking concert was held at the Lancaster Electricity Works on Tuesday evening last, Mr. Milnes being in the chair. Mr. Tester was presented with a testimonial subscribed for by the staff, upon his leaving the works to take up an important position in South Africa. Mr. W. Benson, the oldest employé, made the presentation.

Mr. Herbert F. Reeman has resigned his position as assistant engineer at Montrose, to take up the appointment of chief assistant engineer to the Derbyshire and Nottinghamshire Electric Power Co. He has just been presented with a fountain pen by the Montrose staff.

Tramway Officials.—The staff of the Burton-on-Trent tramways have presented an aneroid barometer to Mr. P. J. Pringle, tramway manager and electrical engineer, who is leaving for Australia, with an entrée dish for Mrs. Pringle.

General.—Last week Mr. J. Henniker Heaton was the guest of honour at a dinner of the Association of Men of Kent and Kentish Men, when the P.M.G. expressed his regret that the occasion marked the retirement of Mr. Heaton from active public life.

Mr. H. N. Sporborg, chief engineer, and Mr. W. C. Lusk, manager of export department, of the British Thomson-Houston Co., Ltd., have been appointed members of the board of directors.

The *Times of India* states that Mr. Gibbs, chief electrical engineer in Mysore, who is at present in Bombay in connection with the Tata hydro-electric scheme, has been offered the appointment of director, to which the Mysore Government have no objection. The Maharajah of Mysore State has invested several lakhs in the project.

Mr. Walter H. Tittensor, M.I.E.E., Scottish manager for Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, has resigned his position to take up the post of general manager of the tramways and lighting system in Kingston, Jamaica, for the West India Electric Co., Ltd. Mr. Tittensor sails on December 24th, from Bristol, and will be pleased to receive lists and particulars from manufacturers of tramway and electrical supplies, addressed to 63, Frederick Street, Glasgow.

Mr. D. C. M. Hume has been appointed consulting electrical engineer to the London and General Electric Theatres, Ltd., whose plans provide for upwards of 40 theatres at the moment. Mr. Hume's theatro-technical experience was gained in association with Mr. Wingfield Bowles, the theatre consulting engineer, who was responsible for the London Coliseum and other famous houses.

Obituary.—Mr. Robert Gilmour.—The death occurred suddenly last week at his residence of Mr. Robert Gilmour, district manager of the National Telephone Co. in Edinburgh. Mr. Gilmour was 45 years of age. The *Glasgow Herald* says that, after nine months in the telephone service in that town, he was transferred to Glasgow, where he became exchange inspector. He became local manager at Kilmarnock in 1886, and subsequently acted as superintendent of sub-exchanges south of the Forth, district manager at Aberdeen, district manager at Dundee, and district manager in Ulster, being in July, 1909, appointed district manager in Edinburgh.

Mr. David Pitcairn.—The death is reported of Mr. David Pitcairn, a director of the Harrow Electric Light Co., Ltd., at the age of 76 years.

NEW COMPANIES REGISTERED.

Electric Water-Heaters, Ltd. (7,701).—This company was registered in Edinburgh on November 14th, with a capital of £2,000 in £1 shares, to carry on the business of makers and installers of heating apparatus, &c. The subscribers (with one share each) are:—R. Lauder, 12, Cambridge Lane, Glasgow, manufacturing chemist; J. M. Davies, jun., 168, St. Vincent Street, Glasgow, chartered accountant. Private company. The first directors are not named. Registered office, 168, St. Vincent Street, Glasgow.

Sandwich, Deal and Walmer Electricity Supply Co., Ltd. 112,750).—This company was registered on Novemb r 16th, with a capital of £4,000 in £1 shares, to carry on in Sandwich, Deal, Walmer, Eastry, Dover and elsewhere, the business of an electric lighting, power and supply company in all its branches. The subscribers are :—J. Wills, Great Mongeham, Deal, estate agent, 100 shares ; J. Edgar, Deal, preserved provision manufacturer, 100 shares ; E. H. Hinds, Louisa House, Walmer, estate agent, 100 shares ; R. H. Luptage, M.I.C.E., Sheen House, Walmer, 50 shares ; T. T. Denne, Walmer, contractor, 100 shares ; Sir William H. Crundall, Kt., Woodside, Kearsney, timber merchant, 100 shares ; H. M. Mowll, 36, Castle Street, Dover, solicitor, 100 shares. Private company. The number of directors is not to be less than three or more than seven ; the first are J. Edgar, T. T. Denne, and Sir William H. Crundall ; qualification, £100 ; remuneration, £100 each per annum (chairman £200). Each share confers one vote. Directors' borrowing powers restricted to the amount of the share capital agreed to be issued. Registered by Mowll & Mowll, Howard House, Arundel Street, Strand, W.C.

M. Clark Co., Ltd. (112,897).—This company was registered on November 25th, with a capital of £20,100 in 100 founders' and 20,000 ordinary shares of £1 each, to carry on the business of contractors for and managers of public and other works and conveniences, including railways, tramways, docks, electric light works, telegraphs, telephones, markets, &c. The subscribers (with one share each) are :—F. H. Rapley, 9, New Broad Street, E.C., civil engineer ; E. C. C. Smith, 235-9, Finsbury Pavement House, E.C., incorporated accountant. Private company. The number of directors is not to be less than three or more than five ; the first are M. Clark (permanent governing director), F. H. Rapley and E. C. C. Smith ; qualification, £20 ; remuneration as fixed by the company. Registered office, Dashwood House, New Broad Street, E.C.

Anglo-Foreign Tramway Syndicate, Ltd. (112,859).—This company was registered on November 24th, with a capital of £10,000 in 9,500 preference shares of £1 each, and 5,000 "A," 4,000 "B," and 1,000 ordinary shares of 1s. each, to carry on the business indicated by the title. The subscribers (with one preference share each) are :—R. R. Reeves, 9, Great St. Helens, E.C., clerk ; A. W. R. Stuart, 4, College Street, Barnsbury, accountant. Private company. The number of directors is not to be less than two or more than five, the subscribers are to appoint the first. Registered office, Electra House, Finsbury Pavement, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Nottinghamshire and Derbyshire Tramways Development Co., Ltd. (75,577).—Issue on October 27th of £200 debentures, part of a series of which particulars have already been filed.

Electrical Contracts and Maintenance Co., Ltd. (101,757).—Issue on November 11th of £50 debentures, part of a series of which particulars have already been filed.

Wrexham Motor and Electrical Engineering Co., Ltd.—A statement of the total amount outstanding on July 1st, 1908, in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars : Charge dated January 6th, 1906, securing £600.

Tubes, Ltd. (91,224).—Return dated July 8th, filed September 23rd, 1910. Capital £100,000 in £1 shares. All shares taken up ; £82,859 paid ; £17,141 considered as paid. Mortgages and charges : £46,902 8s. 8d.

Bedford & Co. (Cardiff), Ltd.—Particulars of £100 debentures, created November 12th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged : The company's undertaking and property, present and future, including uncalled capital. No trustees.

London Electric Treatment Institute, Ltd. (106,854).—Particulars of £525 debentures, created November 3rd, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of present issue being £425. Property charged : The company's undertaking and property, present and future, including uncalled capital. No trustees.

COST KEEPING IN SMALL FACTORIES.

Detailed cost keeping is becoming increasingly important year by year as competition compels a more careful study of economy. Large concerns have long since instituted elaborate systems for recording every item going to make up the cost of producing each part manufactured, and these methods are gradually working their way downwards into the smaller undertakings, which are now feeling the effect of lower prices. These elaborate systems involve the employment of experts whose whole time is taken up in carrying out their especial duties, whilst a high order of intelligence is needed in the manager to enable him to grasp the complex methods requisite for the effective control of a large manufacturing concern. These features are absent in smaller undertakings, in which the additional clerical work involved by the cost system must be carried out in conjunction with other duties, and where the salary of a highly trained manager would be a serious item, hence simpler methods are resorted to which can be easily worked by the ordinary staff.

In this connection, a recent article in the *Engineering Magazine*, on "Cost Keeping in Small Factories," by Paul R. Powell, is of particular interest, as it contains a description of a system stated to be applicable to concerns employing 25 to 250 men. There is no doubt the system put forward is on the right lines, but more detail might have been given with advantage, whilst certain modifications would be advocated by many who are conversant with the difficulties to be contended with. For instance, the method of replacing the stores ledger by cards affixed to the bins is not an unmixed blessing, as it involves immediate entries by the person giving out the parts, whilst the keeping up of the stock entails an irksome reference to scattered and awkwardly placed records. Other points upon which a diversity of opinion exists, include the absence of a list of parts for the complete product, no effective system of reference numbers, the unnecessary introduction of machine numbers, and the booking of their time by the workmen themselves.

Apart from these points, the article contains a good deal of useful matter, and may be advantageously studied by those responsible for the control of small factories. Considerable modification would, however, be needed in any system for cost keeping in concerns differing so greatly as to the number of employés.

MUNICIPAL CO-OPERATION WITH PRIVATE ENTERPRISE.

An interesting example of municipal co-operation with private enterprise in Sweden is afforded in the case of the Sydsvenska Kraftaktiebolaget, whose large hydro-electric works were recently started near Lagan. The company was formed in 1906 to utilise the water-power of the Lagan River, which is the largest in Sweden, and to provide a supply of light and power to the towns and neighbouring works interested in the company, the largest shareholders being the towns of Malmö, Lund, Helsingborg, Landskrona, and Halmstad. Work on the erection of the power stations was commenced in 1907, and three-phase current is used at 50 periods, and is transformed up to 50,000 volts for distant transmission. The company provides the transmission mains as far as the places of consumption, and they extend over considerable portions of the provinces of Schonen and Halland. At present the lines between Knared and Halmstad, a distance of 24·8 miles, and between Knared and Trelleborg, which are 93 miles apart, are in operation, with connections to Engelholm, Helsingborg, Landskrona, Malmö, Lund, and other towns. The prices charged to the towns as shareholders are low, and are based upon the low-tension supply from the transformers furnished by the company, whilst the further the place of consumption is situated from the four power stations, which are about eight miles apart, the higher the price is to be in the case of private users, in view of the cost of transmission and conversion. Most of the plant used is of native manufacture, the remainder being of German and Swiss origin. As a result of the very active demand for power, it is hoped that the company will soon begin to utilise the other waterfalls at its disposal.

Douglas Southern Electric Tramways, Ltd.—In their annual report the directors state that the company's season consisted of 133 days, against 125 days last season, and the mileage run was 36,739, as against 36,570 last year. The total receipts for the season are £4,812, against £4,790, an increase of £22. The weather during August, the most important month, was wet and cold, and this, combined with an unsettled state of trade, had an adverse effect on traffic. The passengers carried were 196,088, as against 194,826 last year. The net profit for the year is £1,483, as against £1,522, plus £154 brought forward. The directors recommend a dividend of 5 per cent. on the preference shares, absorbing £1,299, leaving £338 to be carried forward. With the exception of £37 10s. 11d. owing to sundry creditors and on account of unclaimed dividends, their are no debts, debentures, mortgages, or other incumbrances whatever on the company's property, and the buildings, rolling stock, boilers, engines, electrical equipment, and permanent way have been kept in a high state of efficiency out of revenue. There has again been an entire absence of accident to either passengers or property.

Electromobile Co., Ltd.—A meeting of this company was held on Monday, at 7, Hertford Street, Park Lane. A representative of the Electrical Review, who attended, was informed that it was a "private shareholders' meeting, and the Press could not be admitted."

Bank Rate.—The Bank Rate was yesterday reduced to 4½ per cent.

CITY NOTES.

Adelaide Electric Supply Co., Ltd.

The directors' report for the year ended August 31st, 1910, states that the profit and loss account shows a credit balance for the year of £42,239. After payment of the dividend on the preference shares for the half-year ended February 28th, 1910, there remains, including the amount carried forward, an available balance of £38,551, which is to be applied as follows:—To dividend on 30,000 6 per cent. preference shares for the half-year ended August 31st, 1910 (paid September 1st), £4,500; to dividend of 7 per cent. on 30,000 ordinary shares for the year ended August 31st, 1910, £10,500; to bonus of 2s. per share on ditto, £3,000; to transfer to depreciation account, £1,000; to transfer to dividend equalisation account, £15,000; balance carried forward, £4,551. During the year a further sum of £38,390 was expended on capital account in the provision of additional land, buildings, plant and mains. The company's mains have now been carried into the majority of the residential and manufacturing districts surrounding the City of Adelaide. The directors propose to continue their policy of energetic development. With a view to providing the necessary funds, the directors will submit a resolution to increase the capital of the company by £100,000 by the creation of 20,000 further ordinary shares of £5 each, and will ask for authority to issue such shares, as and when they think proper, for the purposes of the company. The temporary supply of power to the Adelaide Municipal Tramways Trust has been continued satisfactorily during the year. It is anticipated that the Trust will be in a position to generate their own supply early in 1911, when the company's revenue from this source will cease. The directors again recommend that a portion of the profits be transferred to a dividend equalisation account. The following table sets out the progress made during the past three years:—

Date.	Lighting in 80-watt lamps.	Motors in rated H.P.	Total equiv. connections expressed in 80-watt lamps.	Total units sold.
August 31st, 1907 ..	56,964	1,431 H.P.	102,756	1,384,178
August 31st, 1908 ..	71,138	1,837 H.P.	129,922	1,666,974
August 31st, 1909 ..	91,338	2,869 H.P.	167,146	2,073,550*
August 31st, 1910 ..	112,154	3,101 H.P.	211,386	2,538,062*

* Excluding traction units sold to the Municipal Tramways Trust.

German Investment Companies.

The Electric Light and Power Investments Co. (Elektrische Licht und Kraftanlagen Gesellschaft), of Berlin, which recently called up the unpaid balance on a portion of the ordinary shares, now has a paid share capital of £1,500,000, and an issue of bonds amounting to £1,227,000. According to the directors' report for 1909-10, the year afforded an opportunity for undertaking various large transactions, and the gross profits from investments and underwriting reached £178,000, as compared with £152,000 in the preceding year. After meeting administrative expenses, taxes and interest on the loan capital, the accounts show net profits, including balance forward, of £103,000, as against £85,000 in 1908-9. It is proposed to pay a dividend at the rate of 7 per cent., being the same as in each of the five preceding years. The stock of securities has risen from £1,432,000 in 1908-9, to £1,532,000 at the close of the past financial year, and the underwriting account has advanced from £326,000 to £532,000 in the same periods respectively. It is mentioned that out of the present year's issue of 5 per cent. debentures by the Anglo-Argentine Tramways Co., the Berlin company acquired £50,500, upon which the sum of £27,775 has so far been paid. The directors of the investment company, which has hitherto only been empowered to issue bonds up to the amount of the ordinary share capital, propose to seek an alteration in the statutes, whereby bonds could be issued to any desired extent, and also without obtaining the authority of a general meeting. The adoption of a course of this kind is declared to be quite unusual in the case of an investment company in Germany.

The Electricity Investments Co. (Gesellschaft fur Elektrizitäts Anlagen), of Berlin, which was formerly associated with the Helios Co., and is now connected with the before-mentioned Electric Light and Power Investment Co., owns electricity works at Buhlau, Ottweiler and other towns, in addition to being an investment undertaking. During 1909-10 the company acquired from the Helios Co. the whole, or the majority of the share capital in four works or tramways, and also formed the Saale Electricity Works Co., of Saalfeld, to supply various localities. The net profits and balance forward are returned at £30,100 for 1909-10, as contrasted with £26,900 in the previous year, and a dividend of 7 per cent. is proposed, as against 6 per cent. in 1908-9.

German Schuckert Co.—It is reported on the Berlin Stock Exchange that the Elektrizitäts Gesellschaft vorm Schuckert & Co., of Nuremberg, will propose a dividend of 7 per cent. for 1909-10, as compared with 6 per cent. in the preceding year, and that it is intended to increase the share capital by £500,000 to £3,000,000. The new shares are to provide the company with means for taking over new shares in the Siemens-Schuckert Works, Ltd., which are presumably to raise their capital by £1,000,000 for the purpose of carrying out extensions, and one half of this capital would be subscribed by each of the partners represented by the Siemens & Halske Co. and the Schuckert Electricity Co.

Amazon Telegraph Co., Ltd.

Mr. Geo. Keith (chairman) presided on Tuesday at the offices, 42, Old Broad Street, E.C., over the sixteenth ordinary general meeting of this company.

The Chairman, in moving the adoption of the report (see Electrical Review, page 878), said there was a very satisfactory increase of business as compared with the falling off of the previous year. In the previous year the rubber trade, upon which their business greatly depended, was dull and stagnant, but in the year under review it had been active and prosperous, due more to the abnormal rise in prices than to any increase in the year's crop. The London price of fine Para rubber was carried up in April last to 12s. 6d. a lb., and then fell to a more normal figure in July, and now stood at about 6s. 3d. per lb. Naturally, their business suffered very badly from the interruption which took place in their main cables during the fall of the river last year, but after the turn of the year they worked well, and in March the upper sections, which were most liable to interruptions, were duplicated, with the result that the loss sustained during the first half of the year was more than recovered during the second half, and the business of the whole year showed a very satisfactory increase. The traffic receipts had increased during the year about 11 per cent., and the total revenue, including the subsidy earned by the cables, and the interest, amounted to £86,562, or £9,196 more than it was in the previous year. In comparing the working expenditure, the expenses of stations were £619 less, and those in London £53 more. The expenses attending the maintenance of cables were £2,292 more, due to the great increase in the number of repairs which had to be carried out during last fall. For over three months their repairing vessel and staff were hard at work repairing the interruptions caused by the landslips in the banks and the upper reaches of the river. The aggregate of the other items of expenditure showed a satisfactory decrease of £496. Altogether the working expenditure amounted to £49,922, or £1,230 more than in the previous year. The charges against the year's revenue had been considerably modified by the issue of the new 5 per cent. debentures amounting to £300,000, which were authorised at the last meeting, and by the repayment of the old 6 per cent. The change from the old to the new debentures had increased somewhat the interest charges of the year, and the cost of issuing the new debentures had also been charged to the year's revenue, but no charge had been made for the half-yearly redemption which had been postponed for two years in order that the charge required for that purpose should be used to commence the establishment of a reserve fund for renewal and maintenance of the cables. The result of the year's business was a surplus for the year of £7,593, which, after taking into account the sinking fund, &c., as shown in the accounts, reduced the debit balance standing against revenue account to £18,493. Altogether, he thought they might be well satisfied with the company's financial position. The balance-sheet was now in order, with a full certificate from the auditors without the reservation hitherto mentioned, and the company was in the position to clear off the debit balance, and to provide the additional capital required to complete the duplication of the main cables. The duplication expenditure for the year amounted to £142,769, which had been carried to cable expenditure account. About two-thirds of the new cable had already been laid, the work having been successfully carried out by their own staff, under the able superintendence of their general manager and engineer. The cost of laying the trench cable required to join the side waters of the river had been greatly increased by the higher cost of labour, due to the prosperity in the rubber trade. The third, or last portion of the new cable, which was being shipped when the report was issued, was now on its way up the Amazon, and it was expected that the whole cable would be fully completed and in working order early in January. The duplication of the main cables was proving a great success, and with the exception of one or two stretches on the lower section which had still to be duplicated, they had been able to maintain uninterrupted communication this year during the fall of the river that last year was so disastrous to the single line of cable. Business generally in the Amazon continued to be very active and prosperous, and up to the present this year the traffic passing over the cables showed a marked improvement. If all went well, as at present, he thought they might look forward to a very favourable result for the current year.

Mr. E. B. Ellice Clarke seconded the motion.

Replying to a Shareholder, the Chairman said that there were a number of small businesses on the Amazon, but their traffic depended almost entirely on the rubber trade.

Mr. C. W. Parish: There is a very good business in revolutions this month.

The report was carried, and thanks were accorded the board.

Continental.—Germany.—The Rheinische Schuckert Gesellschaft für Elektrische Industrie, of Mannheim, is declaring a dividend at the rate of 7 per cent. for the last financial year, the same as for the preceding 12 months.

Belgium.—The report of the Société Siemens et Halske, of Brussels, for the last financial year, shows a profit of £64,348, out of which a dividend at the rate of 4 per cent. is being declared.

Italy.—La Società Elettricita Alta Italia, of Turin, proposes to increase its capital from £600,000 to £1,000,000, with the view of extending its operations.

Cleveland and Durham Electric Power, Ltd.—The petition for confirming the reduction of capital, recently agreed to, is to be heard in London on December 13th.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.	£*	No. of wks.	Total to date.	£*	Route miles open.	Inc.
Aberdeen	Nov. 23	2,472	+ 212	25	36,854	+ 346	..	..
Ayr	„ 26	347	+ 16	28	9,986	+ 371	8	..
Bath	„ 26	1,254	+ 27	47	38,342	+ 1,971	..	..
Belfast	„ 25	7,897	+ 927	34	139,565	+ 8,302	37	..
Birkenhead	„ 27	1,979	+ 129	34	38,021	+ 967	13·6	..
Birmingham Corp.	„ 19	13,721	+ 540	33	226,198	+ 4,305	56·4	..
Blackburn	„ 23	1,901	— 167	34½	37,462	— 1,295	14·12	·12
Blackpool Corp.	„ 17	707	+ 29	..	48,889	+ 292	..	..
Blackpool-Fleetw'd	„ 26	416	— 2	21	22,512	+ 646	..	..
Bolton	„ 20	4,591	+ 276	34	80,149	+ 361	26	..
Bournemouth	„ 23	2,584	+ 132	33½	64,448	+ 5,038	21·9	..
Bradford	„ 19	9,518	+ 410	34	172,473	+ 6,781	54·8	..
Brighton	„ 27	1,407	+ 15	34½	35,651	+ 243	9·5	..
Bristol	„ 25	10,747	+ 846	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	„ 18	426	+ 3	46	10,120	+ 71	3·65	..
Barnsley	„ 18	333	- 2	46	7,958	+ 195	..	..
Barrow	„ 18	447	+ 39	46	12,317	+ 1,592	5·37	..
Cavehill	„ 18	116	— 3	46	4,209	+ 217	..	..
Devonport	„ 18	788	+ 120	46	19,725	+ 2,791	8·85	..
Gateshead	„ 18	1,949	— 14	46	43,731	— 45	11·25	..
Gravesend	„ 18	861	— 23	46	9,581	— 158	6·5	..
Greenock	„ 18	922	— 65	46	28,578	+ 2,937	7·25	..
Hartlepool	„ 18	375	— 56	46	11,448	+ 562	6·72	..
Kidderminster	„ 18	167	— 5	46	5,147	+ 158	..	..
‡Leamington	„ 18	286	+ 11	46	7,890	— 291	..	..
Merthyr	„ 18	379	+ 19	46	9,563	— 132	2·9	..
Metropolitan	„ 18	13,818	+1,904	46	346,590	+59,202	22	..
Middleton	„ 18	543	— 85	46	14,813	— 844	8·5	..
Mid. Joint Com'tee	„ 18	11,444	+ 206	46	268,155	+ 3,960	..	..
Oldham—Ashton	„ 18	1,042	— 51	46	25,655	— 232	9·13	..
Peterborough	„ 18	194	— 10	46	5,100	— 90	5·31	..
Potteries	„ 18	3,844	+ 63	46	82,308	— 4·0	29	..
Rothesay	„ 18	75	+ 4	46	9,916	+ 163	2·75	..
Southport	„ 18	459	+ 27	46	13,633	+ 287	8·17	..
S. Metropolitan	„ 18	1,335	— 95	46	38,148	+ 1,202	..	..
Swansea	„ 18	2,077	+ 199	46	50,146	+ 5,175	12·5	..
Tynemouth	„ 18	294	— 13	46	11,922	+ 528	3·75	..
Weston-s-Mare	„ 18	56	— 14	46	7,043	— 17	3	..
‡Worcester	„ 18	472	+ 22	46	13,161	+ 252	5·75	..
Wrexham	„ 18	172	— 3	46	4,494	— 51	..	..
Yorks. Wool. Dist.	„ 18	1,893	+ 42	46	45,762	+ 3,248	17	..
Miscellaneous	„ 18	338	— 39	46	9,594	+ 229	..	..
Burnley	„ 26	2,328	+ 117	..	..	..	11·6	1
Burton-on-Trent	„ 27	472	+ 18	34	9,464	+ 199	6·62	..
Bury	„ 27	2,092	+ 164	34½	40,927	— 38	22·5	..
Cardiff	„ 19	4,066	+ 102	34	76,417	+ 965	..	..
Carlisle	..	..	..	..	..	..	..	..
†Chatham and Dist.	„ 17	730	+ 12	46	39,544	+ 1,420	14·98	..
Cork	„ 24	863	+ 89	..	23,004	+ 1,797	9·9	..
†Croydon	„ 11	1,451	— 129	..	55,168	+ 3,384	11·25	..
Darlington	„ 26	393	+ 33	35	7,043	+ 551	..	..
Darwen	„ 18	487	+ 5	33	8,327	— 80	4·36	..
Dover	„ 19	361	+ 58	33	7,776	+ 322	4·75	..
Dublin	„ 25	9,778	+ 472	..	120,576	+ 2,466	54·25	..
Dundee	„ 23	2,174	+ 30	27½	32,698	+ 567	15	..
East Ham	„ 26	1,837	+ 101	34	36,032	+ 1,549	7.87	1
Exeter	„ 25	515	+ 37	34	11,307	+ 591	5·5	..
Glasgow	„ 26	33,578	+2,636	..	458,113	+25,119	97·75	3·25
Hastings	„ 24	1,309	— 82	..	47,491	+ 295	..	..
Huddersfield	„ 26	3,450	+ 361	35	61,097	+ 3,354	28·5	..
Hull	„ 26	5,310	+ 257	34	94,191	+ 4,800	14·5	..
Ilkeston	„ 24	235	— 8	34	4,465	— 220	..	..
Ipswich	„ 26	622	+ 25	34	15,071	+ 748	10·5	..
Kilmarnock	„ 19	276	+ 23	27	4,183	+ 161	4·25	..
Lancashire United	„ 23	2,306	+ 47	..	61,461	— 415	39	..
Leeds	„ 26	12,950	+ 360	34	243,240	+ 7,482	..	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 26	990	+ 2	27½	17,364	+ 68	8·72	..
Liverpool	„ 12	22,047	+ 888	45½	502,246	+16,846	116	6·5
‡L.C.C.	„ 16	90,740	+6,210	..	1,383,213	+161,971	134	9
London United	„ 26	9,657	— 157	..	297,182	+12,006	..	..
Lowestoft	..	..	..	..	..	..	..	..
Manchester	„ 26	29,066	+1,620	34	590,806	+12,410	183	1
Newcastle	„ 26	7,869	— 267	..	135,718	— 746	14·5	..
Newport	„ 19	1,270	+ 112	34	23,877	+ 754	14·5	..
Oldham	„ 27	3,515	+ 482	35	65,307	+ 64	23·75	..
Pontypridd	..	..	..	..	..	..	..	..
Portsmouth	„ 19	3,103	— 218	33	71,709	— 1,633	15½	..
Preston	„ 23	1,371	+ 109	34	25,053	— 368	..	..
Rotherham	..	..	..	..	..	..	..	..
Salford	„ 21	8,828	+ 489	33½	157,819	+ 3,359	..	..
Sheffield	„ 29	11,783	+ 917	35½	211,842	+12,646	40	·25
Southampton	„ 23	1,855	+ 90	34	37,946	+ 872	..	..
Southend-on-Sea	„ 23	735	+ 31	34	21,742	+ 2,449	..	..
South Shields	„ 26	959	— 49	34½	19,576	— 6	..	..
†Swindon	„ 16	135	+ 18	..	4,811	+ 233	..	..
Tyneside	„ 23	652	— 87	21	9,311	+ 56	..	..
Wallasey	„ 12	1,791	+ 129	32½	31,581	+ 574	..	..
†Walthamstow	„ 19	579	+ 56	33	24,366	+ 1,782	9	..
West Ham	„ 17	4,672	+ 364	33	82,483	+ 4,188	15·25	·12
Wolverhampton	„ 23	1,733	+ 136	34	32,147	+ 3,464	14·25	1·75
Cen. London Rly.	„ 26	11,224	— 506	21	113,970	+ 3,774	6·32	..
City & S. Lon. Rly.	„ 27	6,750	— 14	21	66,149	+ 230	7·26	..
Dublin-Lucan Rly.	„ 25	214	+ 13	20	3,183	+ 149	7	..
G.N. and City Rly.	„ 26	3,157	+ 145	21	29,053	+ 921	3·5	..
L'pool Overh'd Rly.	„ 20	2,626	+ 79	..	29,964	+ 424	6·8	4·8
Llandudno-Col. Bay	„ 18	231	+ 4	50½	14,529	+ 423	..	..
London Elec. Ry. Co.	„ 26	27,670	+ 820	21	258,310	+ 2,690	21·25	..
Mersey Railway	„ 26	4,110	— 59	21	41,564	+ 419	4·5	..
†Metropolitan Rly.	„ 20	17,682	+ 318	..	337,013	+10,573	24·5	..
Met. District Rly.	„ 26	23,002	+1,233	21	221,929	+13,982	24	..
Anglo-Argentine	„ 25	97,712	+15,419	..	2,106,931	+252,480	..	..
§Auckland	Oct.	15,073	+1,582	..	60,342	+ 6,627	23·3	1
Bombay (B.E.T.)	Oct. 28	5,701	+ 340	43	116,866	+ 8,588	..	..
§Brisbane	Aug.	21,950	— 47	82	144,795	+13,548	..	..
§Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Nov. 26	8,066	+1,186	..	..	..	..	..
§Cape Electric T. Ltd.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Oct.	3,479	..	..	35,702	..	20·5	..
Madras	Nov. 15	1,304	— 65	..	28,301	+ 1,351	..	..
§Montevideo	Oct.	23,012	+1,688	52	279,990	+26,783	..	..
§Lisbon	..	..	..	..	..	..	..	..
Perth (W.A.)	Nov. 18	2,883	— 2	..	57,976	— 6,816	39	1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

DEARNESS of money is an outstanding factor in the Stock Exchange markets, although the worst of the stringency seems to be over, and there are even hopes of Lombard Street relaxing the pressure on the shady side of the New Year. The Stock Exchange carry-over on Monday showed that people were willing enough to pay at the rate of 7 per cent.—and in some cases more—for financial accommodation over the next fortnight, and in face of such charges as these, the activity prevalent in some of the markets is so much the more surprising.

This applies more particularly to the Home Railway department, where a considerable amount of strength has developed during the week, and the buying both for investor and speculator was large. One feature is the strength of Brighton Deferred, the stock being bought on dividend prospects, which are the more rosy by reason of the success of the electrified portion, an extension of which is under contemplation. Another feature is a rise of 2 in Metropolitan Consolidated, the gain occurring almost wholly in the course of one day, on newspaper articles that drew attention to the comparative neglect suffered by the stock during the recent revival. Districts have retained their advance of last week, and the 4½ per cent. Preference at 86 is ½ higher. East Londons vegetate around 3½.

The purely electrical railway stocks stand alone in their lack of any material improvement. This deserves to be noted by the speculatively-inclined buyer, because the chances run in favour of a rise in Central Londons, while the good yield on City and South London is pretty sure to direct attention to its possibilities, unless the Home Railway boomlet fizzle out to an ignominious end. The issued amount of City and South London Ordinary is but £1,480,000, which explains in some degree the narrowness of the market. At the same time, it is of assistance when a rise is on hand, since the less market there is in a stock, the more easily is the price moved—in either direction. When the Coronation begins to be talked about as a market factor, these Tube stocks can hardly help participating in the result of the bullish atmosphere that will be created.

Mexican stocks and shares had a bad time last week while rumours were current of revolutionaries having assassinated the venerable President Diaz, with other fanciful tales to match. Luckily the rising turned out to be more journalistic than actual, and prices rapidly recovered part of their falls. Lurking doubts remain, however, as to the affair being entirely blown over, and, in consequence, there are declines left in various leading issues.

Mexican Light and Power Common shows a drop of 2, the Preference one of 30s., while the Bonds are down a point. The last-named amount has come off the price, too, of Mexican Electric Light 5 per cent. Bonds, and Monterey Railway, Light and Power 5 per cent. Debenture stock is dull at 91½. Vera Cruz Electric Light, Power and Traction 5 per cent. first Debentures eased off to 94, but this shows a rally from the lowest of last week. On the other hand, Mexican Trams rose 1½, although the 5 per cent. Bonds fell half a point.

Other issues in the group were slightly affected by the flurry in Mexicans, but this is now over. Rio Tramways Gold Bonds drooped to 100½. Further rumours of insurrections in Brazil added to the nervousness for the time being, but confidence was quickly restored by the evidence of wild exaggeration in this matter, too.

Electricity Supply shares are neglected and stagnant. Small falls have occurred in the case of some of the leading companies, but St. James' 3½ per cent. Debenture stock is 1 up, and Urban Debenture gained a point. Mention has already been made here of another Bill which the London undertakings may promote jointly with the local authorities, and this is expected to be put forward in the early part of the New Year.

Telegraph and Telephone issues show more falls than rises, although the tone of the market is hard enough. Eastern Ordinary and Eastern Extensions plod steadily upward. The Anglo division has been dull in sympathy with a slump in American shares. West India and Panama Ordinary went back to 27s. 6d., and the 6 per cent. First Preference fell a further 5s. to 9½.

National Telephone Deferred reacted a little after its violent rise, but the fall did not amount to much. Oriental Telephones are ⅛ lower.

British Electric Tractions are rallying their supporters and their prices, with the result that the Ordinary have hardened to ⅛, and the Debenture stocks both exhibit advances. British Columbia Electric Railway Preferred went back a little, but Cape Electric Trams at 8s. 9d. are ⅛ better.

The manufacturing list is good, with quiet rises in several leading shares. Callender's are ¼ up, India-Rubber 5s., Babcock ½, and so on. Rubber shares display a firm tendency; the Tuesday Mincing Lane sales have been concluded at prices decidedly satisfactory.

"Supposed" Again.—"The outbreak *is supposed* to have been caused by the fusing of an electric wire."—Weekly Newspaper, November 27th, 1910.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Nov. 22nd.	Closing Quotations Nov. 29th.	Business done week ended Nov. 29th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent.
		*										£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	5½ — 6	5½ — 6	6	5⅝	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	97	96⅝	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	144 —147	144 —147	..	..	..	5 8 10
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94½ — 96½	94½ — 96½	..	..	..	4 2 11
558,460	Anglo-American Telegraph	Stock	3⅞%	3⅛%	£3 4s.	3⅜%	65½ — 67½	65½ — 67½	65¾	..	..	5 7 5
3,230,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	106 —108	106 —108	109	106⅝	..	5 11 1
3,230,770	Do. do. do. Deferred	Stock	1⅞%	1 %	8/-	25/-	26½ — 27	26½ — 27	26⅝	26⅜	..	4 12 7
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7⅛ — 7⅝	7 — 7⅛	7	7	— ⅛	5 10 4
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	85	..	..	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½ — 9⅛	8½ — 9⅛	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅝ — 17⅜	16⅝ — 17⅜	17	..	..	5 15 11
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅝ — 3¾	3⅝ — 3¾	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½ — 8⅝	8½ — 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
60,710‡	Direct United States Cable	20	4½%	4½%	4½%	4 %	15 — 15¼	14½ — 15⅝	15½	15	— ⅛	5 4 3
36,000	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..	4 7 10
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	134 —137	135 —138	136½	135½	+1	5 1 5
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83 — 85	83 — 85	84½	83½	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	100 —102	99½—101½	100	..	— ½	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 12⅝	12⅜ — 13	12 13/16	12½	+ ⅛	5 7 8
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	101¼	..	..	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	5⅛%	10¼ — 10⅜	10¼ — 10⅜	10⅝	10⅛	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13¼ — 13⅜	13¼ — 13⅜	13⅝	13⅜	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	18 %	30½ — 31½	30½ — 31½	..	..	+ ½	5 14 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	..	..	..	5 18 7
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	94 — 97	95 — 98	..	..	+1	4 6 9
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	¾ — 1	¾ — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	..	..	..	5 8 4
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	105¼—106½	105¼—106⅝	106⅜	105½	..	5 12 8
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	128 —130	128 —130	129	126¾	..	4 12 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10⅜ — 10⅝	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10⅛ — 10⅜	10⅛ — 10⅜	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 9/16 — 5 11/16	5 9/16 — 5 11/16	5 13/16	5 9/16	..	4 10 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98½—100½	99 —101	99	..	+ ½	3 9 4
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	100	99¼	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1 9/16 — 1 11/16	1 9/16 — 1 11/16	..	..	..	4 14 10
50,000	Do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	31/6	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	88 — 90	88 — 90	89	..	..	4 8 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	98½—100½	99 —101	..	..	+ ½	3 19 7
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98½—100½	98 —100	..	..	— ½	4 9 7
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	6 %	131 —134	131 —134	..	..	..	4 9 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7 5/8 — 7 7/8	7 5/8 — 7 7/8	7⅞	7½	..	5 7 7
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/8	5 1/16 — 5 1/8	5 1/8	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	2½%	1 15/16 — 1 31/32	1 15/16 — 1 31/32	..	..	..	4 12 8
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99½—100¾	99 —101	99⅛	..	+ ⅜	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅜ — 13½	13⅜ — 13⅝	13⅝	13⅜	+ ⅛	5 0 11
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100½—102½	101 —103	..	..	+ ½	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1⅛ — 1⅜	1 5/16 — 1 7/16	27/8	26/6	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref. ..	10	8 %	6 %	6 %	6 %	9⅞ — 10⅛	9⅞ — 10⅛	9⅞	..	— ⅛	5 18 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	9½ — 10	9½ — 10	9⅝	..	..	6 0 0
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	102⅜	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4⅜ — 5	4⅜ — 5	98/9	96/3	..	4 18 9
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4⅛ — 4⅜	4⅛ — 4⅜	90/-	..	..	5 5 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	92 — 93¼	92 — 93½	93⅛	92⅜	..	4 5 7
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
530,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	20	24	5⅛ — 5⅜	5⅜ — 5⅞	5 27/32	5⅝	+ 1/32	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	8 %	8 %	8 %	146 —150	146 —150	147½	..	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	124 —128	123 —127	125	..	—1	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110 —113	110 —113	111¾	..	..	4 8 6
238,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
183,301	British Electric Traction	10	Nil	Nil	Nil	Nil	½ — ⅝	½ — 1	15/-	..	+ ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	Nil	3⅝ — 4⅛	3⅝ — 4⅛	78/9	75/-	..	Nil
1,478,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	88 — 92	89 — 93	90½	89½	+1	5 7 6
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	72 — 77	74 — 79	..	..	+2	5 13 9
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	6⅞	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6	5⅞ — 6	..	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	5/16 — 9/16	5/16 — 9/16	..	..	..	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	59½	..	..	6 9 1
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref... ..	2	Nil	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	..	..	..	18 19 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4½ — 5	4½ — 5	..	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,390..	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 17 7
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9 — 9½	9⅛ — 9⅝	9⅛	..	+ ⅛	5 3 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 15/16 — 5 1/16	4 15/16 — 5 1/16	..	..	..	4 5 9
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	105⅛	..	..	4 4 11
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	5/16 — 7/16	5/16 — 7/16	..	..	+ 1/16	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	17½%	3 5/16 — 3 9/32	3 5/16 — 3 9/32	65/6	64/6	..	5 7 4
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	62 — 64	63 — 65	63⅞	63⅛	+1	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	44 — 46	44 — 46	45	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2½%	2½%	1½%	1½%	26½ — 27½	26½ — 27½	27	26½	..	6 7 3
86,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	¼ — ½	¼ — ½	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 22nd.	Closing Quotations Nov. 29th.	Business done week ended Nov. 29th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	5 %	37 — 31/32	37 — 31/32	..	..	..	5 11 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 7/32 — 1 9/32	1 7/32 — 1 9/32	..	..	..	5 11 8
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	2½%	Nil	Nil	0 — 1/8	0 — 1/8	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½%	2½%	Nil	Nil	1 — 1½	1 — 1½	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	1/4 — 3/4	1/4 — 3/4	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1½ — 1¾	1½ — 1¾	35/-	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8½ — 8⅝	8½ — 8⅝	..	..	..	5 15 7
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½%	Nil	Nil	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10⅜	10¼ — 10⅜	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103½	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12½ — 12¾	12½ — 12¾	12½	..	..	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 1/16 — 5 3/16	5 1/16 — 5 3/16	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107⅞—109½	107⅞—109½	..	..	..	4 2 2
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15 — 15⅝	15½ — 16	..	..	+ ½	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½%	Nil	Nil	1 — 1⅛	1 — 1⅛	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6⅜ — 7½	6⅜ — 7½	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,077	10	3 %	3 %	Nil	..	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜%	Nil	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	..	..	..	5 12 8
5,732,062	Metropolitan Consolidated	100	1 %	½%	½%	1 %	37⅜ — 38½	39⅜ — 40½	40½	38	+2	2 9 8
2,640,914	Do. Surplus Lands	100	2¾%	2¾%	2¾%	2¾%	64 — 66	64 — 66	65½	64½	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	25⅛ — 25⅜	25⅛ — 25⅜	25⅛	25⅛	..	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½%	5%	1 3/16 — 1 5/16	1 3/16 — 1 5/16	16/-	15/3	..	6 3 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	Nil
600,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	17/-	16/3	..	5 9 7
695,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	100	99½	..	4 9 1
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	122 —124	123½—125½	124½	121⅝	+1½	4 15 7
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	..	5 %	97⅝— 98½	96 — 98	97⅞	96	—1	5 2 0
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	1/4 — 5/16	1/4 — 5/16	4/6	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/2 — 5/8	1/2 — 5/8	11/6	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	36 — 38	36 — 38	..	..	..	5 10 3
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 — 103	101 —103	..	..	..	3 17 8
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	..	5 %	100 —101	100 —101	100⅜	..	..	4 19 0
2,800,000	Do. do. 4½ % Bonds	..	..	..	..	4½%	94 — 96	94 — 96	95¼	94⅜	..	4 13 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	37 — 39	37 — 39	38¼	37⅛	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	3/8 — 7/16	3/8 — 7/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	60 — 70	60 — 70	..	..	..	5 14 4

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	6⅞— 7⅜	6⅞— 7⅜	7 7/16	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞— 7⅜	6⅞— 7⅜	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅞— 4¼	3⅞— 4⅛	78/9	75/-	— ⅛	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛— 4⅜	4⅛— 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞— 4¼	3⅞— 4¼	..	..	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 2 6
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	3⅛— 3⅜	3⅛— 3⅜	69/-	65/7½	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	99⅜	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 — 11½	11 — 11½	11⅜	..	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12¼	11½ — 12¼	12	..	..	4 19 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99½—102⅜	99½—102½	..	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1½ — 2	1½ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94½ — 96½	94½ — 96½	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅞ — 7¾	7⅞ — 7¾	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅝ — 11⅛	10⅝ — 11⅛	11	10⅜	— ⅛	5 5 6
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104⅛—107⅜	104⅛—107⅜	..	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	100½	99¼	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	3/8 — 7/16	5/8 — 3/4	..	..	+ 1/16	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1½ — 2	1½ — 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
$8,150,000	Electrical Dev.Co.of Ontario,5%1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	81½ — 84½	81½ — 84½	83	..	..	5 18 4
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 4⅝	4½ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4½ — 5⅛	4½ — 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	6¾ — 7	6¾ — 7	..	..	..	6 1 5
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	103 —105	103½—105½	104½	..	+ ⅛	4 14 9
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6⅞— 7¼	6⅞— 7	..	..	— ¼	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited,Ord.	3	4 %	2½%	3 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 2 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅛— 5⅛	4⅛— 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½ %	4½%	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	3½ — 3⅝	3½ — 3⅝	65/6	62/6	..	6 17 11
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅛— 4⅜	4⅛— 4⅜	..	..	..	4 17 4
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	82 — 85	82 — 85	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	$100	5 %	5 %	5 %	5 %	88½ — 90½	88 — 89	88¾	86¾	..	5 10 6
12,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½%	4 %	90 — 91	87⅞ — 89⅛	89¼	87⅛	—2	4 9 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	105⅞—106⅞	104 —106	105⅞	104	—1	6 12 1
12,000,000	Do. do. 5% 1st Mtg.Gold Bnds.	100	..	..	5 %	5 %	93 — 94	92 — 93	93	90¼	—1	5 7 6
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..	4 11 10
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12 — 13	12 — 13	..	..	..	5 7 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6½ — 6¾	6½ — 6¾	..	..	..	5 8 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½%	6 %	8 %	9 %	225—235	225 —235	235	232	..	3 3 5
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	100—110	100 —110	108	..	..	5 9 1
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100½—102½	100½—102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅝ — 8	7⅝ — 8	..	..	..	6 5 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅜	6⅞ — 7⅜	..	..	..	4 14 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	85 — 87	86 — 88	..	..	+1	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
180,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	3/8 — 7/16	3/8 — 7/16	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	79 — 81	80 — 82	..	..	+1	5 9 9
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	3/8 — 7/16	3/8 — 7/16	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	7½ — 8½	7½ — 8½	..	..	..	6 1 3
61,379	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5⅛	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

STREET-LIGHTING COSTS.

BY C. TOONE.

(*Concluded from page* 860.)

Analysis of Annual Costs.—Owing to the very divergent and varying factors going to make up these costs, no useful end will be served by attempting to analyse completely the average costs shown in Table I, especially as such dissections have been demonstrated from time to time in the past. It has been pointed out that the charges are in many cases unsuitable—being too high or too low, as the case may be—so that logical resolution of costs would be impracticable in such instances. Generalisation in the present respect, even where not impossible, is at least too cumbersome to be of practical value, but the subjoined information will enable every engineer rapidly to determine a reasonable annual charge for various lamps in his own district. The prices, &c., stated below are based on current estimates and assume purchase and handling in fairly large quantities, such as would naturally be required in the working of a street lighting system.

The total annual cost A per lamp (in pounds) may be regarded as made up of the following items :—

A = capital charges on the installation cost of cable, switches, poles, lanterns, lamps, &c. (if there be n lamps per pole, the charges on the first four items are equally divided between the n lamps) + renewal charges (mainly of filament lamps, but inclusive of all necessary repairs) + carbon costs in the case of arc lamps + energy costs + attendance costs, including the renewal of filament lamps, "trimming" arc lamps, and so on—

$$= £\,\frac{C}{100}(p+d) + \frac{H}{L}\cdot\frac{R}{240} + \frac{H(e+f)}{240} + \frac{H\,.\,W}{1{,}000}\cdot\frac{B}{240} + \frac{365\,a}{240}$$

$$= £\,\frac{C}{100}(p+d) + \frac{H}{240}\left(\frac{R}{L} + (e+f) + \frac{B\,W}{1{,}000}\right) + 1{\cdot}52\,a,$$

where a = attendance charge per diem (pence).
B = cost per B.T.U. (pence).
C = capital cost per lamp, as above defined (pounds).
d = per cent. depreciation per annum ; p = per cent. interest per annum.
e, f = cost per hour for $+^{ve}$ and $-^{ve}$ carbons respectively (pence).
H = burning hours per annum (fig. 5).
L = life of lamp (hours).
R = cost of renewal of lamp (pence).
W = lamp consumption (watts).

To enable the ready computation of each of these cost items the following notes are presented. Their purpose and method of use is obvious ; such comments as are necessary are included in each section.

1. *Capital Costs.—(a) Cables.*—In figs. 6 and 7 are shown the net costs of various grades of cables suitable for incandescent lamp and arc lamp circuits respectively. The cables are assumed throughout to be of high conductivity copper, tinned and covered with pure and vulcanised rubber, taped, braided, and the whole treated with preservative compound. These cables are, of course, only intended for use as distributing leads to the lamps from the main cables. The copper section assumed in each case is as below, this being the usual standard allowance, assuming a current density of 1,000 amps. per sq. in.

Incandescent lamp cables. Current capacity.	Copper section.	Arc lamp cables. Current capacity.	Copper section.
0·62 amps.	No. 22 S.W.G.	3·0 amps.	3/20
1·02 ,,	No. 20 S.W.G.	4·9 ,,	7/21½
1·81 ,,	No. 18 S.W.G.	7·0 ,,	7/20
3·22 ,,	No. 16 S.W.G.	12·5 ,,	7/18
5·03 ,,	No. 14 S.W.G.	22·2 ,,	7/16
8·50 ,,	No. 12 S.W.G.	—	—

(b) Switches.—In the following table the knife switches are presumed to be of quite plain, but strong, construction, and mounted on slate slabs without enclosure of any description. Such switches are suitable for installation in the pedestals of arc lamp poles.

Current capacity of switch.	Voltage.	Cost.	Type of switch.
Up to 5 amps.	200	1/3 single pole. 3/6 double pole.	Ordinary. Tumbler.
,, 10 ,,	200	2/6 single pole. 7/- double pole.	,, ,,
,, 10 ,,	200	4/- single pole. 10/- double pole.	Watertight
,, 15 ,,	250	12/- to 15/-	D.P. knife.
,, 25 ,,	400 to 500	5/- to 7/6	S.P. knife.
,, 25 ,,	400 to 500	9/- to 17/-	D.P. knife.
,, 50 ,,	400 to 600	7/- to 15/-	S.P. knife.
,, 50 ,,	400 to 600	14/- to 30/-	D.P. knife.

In many cases the switch costs will be higher than the above, which are the minimum, consistent with reasonable quality of goods.

(*c*) *Poles.*—The cost of poles is very variable, on account of the wide range of variation in weight of poles of given

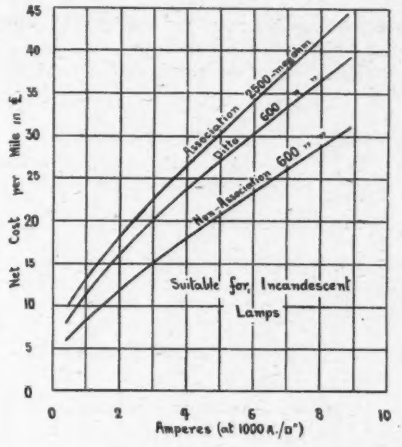


FIG. 6.

height, and on account of the differences existing in the complexity of various designs. Taking heights, from the ground-level to the centre of the lamp, of 20 ft. and 25 ft.

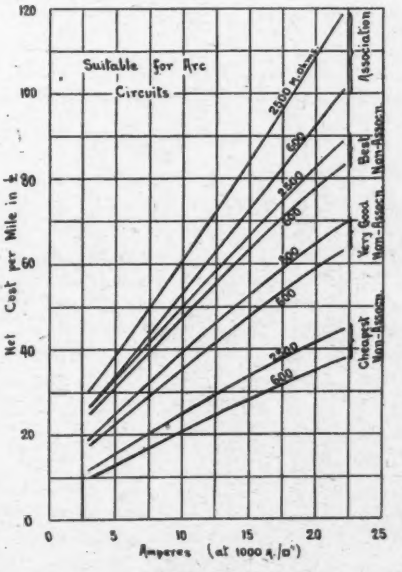


FIG. 7.

as standard, the cost per pole, on a per dozen basis, of various arc lamp poles is :—

	Dead plain.	Slightly ornamental head and pedestal.	Medium ornamental.	Highly ornamental.
20 ft. (each) ...	£3 10	£5 0	£10	£14 to £17
25 ft. (each) ...	4 0	5 10	10	15 to 18

If less than one dozen of these poles be required, their cost will be increased by about 20 per cent. ; incandescent

lamp brackets can be fitted to such poles at a cost of from 10s. 6d. per bracket upwards, according to the complexity of the latter. Lattice poles are seldom employed in street lighting in this country; their cost for a height of 25 ft. is about 10s. per foot. Poles from 12 ft. to 15 ft. high, suitable for use with incandescent filament lamps, cost £2 to £3 each (on a per dozen basis) if reasonably plain, and from £4 upwards if ornamental.

Cost of Hoisting Gear.—Arc lamps are frequently equipped with hoisting-gear to allow of their cleaning, &c., at the ground-level.

Simple winch and rope equipments (entirely outside the pole) cost £1 to £2 complete; counterbalance weight types of hoisting gear (excluding rope) cost £1 to £2; flexible steel rope, $\frac{1}{8}$ in.-$\frac{1}{4}$ in. diameter, costs 10s. to 15s. per 100 ft.; hoisting winches cost 10s. up to 20s. (in heaviest builds); rope guides (as used with lattice poles), 15s. to £1; lamp "cradle" for top of mast (as used with lattice poles), 25s. to 35s.; arc lamp "couplings" with "strain release," £1 5s. to £2 5s.

(d) Lanterns.—The cost of plain standard lanterns suitable for street service, and excluding lamps and lamp-holders and all labour of fitting, is as follows. To take—

One lamp.	Two lamps.	Three lamps.	Four lamps.	Five lamps.	Six lamps.
10s. to 20s.	17s. to 24s.	18s. to 26s.	20s. to 30s.	25s. to 35s.	30s. to 45s.

A lantern and globe for small Nernst lamps costs 7s. to 10s., while the more elaborate pattern frequently employed to give Nernst lamps the external appearance of small arc lamps costs:—

For the ½-amp. lamp, 25s.
For the 1-amp. lamp, 30s.
For the (3 × ½) = 1½-amp. lamp, 65s.
For the (3 × 1) = 3-amp. lamp, 70s.

(e) Lamps.—The current average costs of various filament lamps by standard makers are given in Table VI; these prices are the net terms obtainable, buying in fairly wholesale quantities. The C.P. in Table VI may be taken as Hefner C.P., though the cost of British-made lamps of the same

TABLE VI.

Voltage.		Candle-power. 16	25	32	50	100	150	200	300	400
50	Carbon fil'm't	1/-	1/2	1/5	2/5	—	—	—	—	—
	Metallic „	2/-	2/5	2/5	3/3	—	—	—	—	—
100	Carbon fil'm't	1/2	1/6	1/10	2/5	4/5	7/2	—	—	—
	Metallic „	2/3	2/3	2/5	3/3	5/5	8/-	10/10	14/10	18/10
130	Carbon fil'm't	1/3	1/7	2/-	2/7	4/7	7/7	—	—	—
	Metallic „	2/3	2/7	2/10	3/7	6/-	8/5	10/10	14/10	18/10
200	Carbon fil'm't	1/5	1/9	2/1	2/10	4/7	7/7	—	—	—
	Metallic „	—	3/-	3/3	3/10	6/10	9/5	12/-	16/-	20/-
250	Carbon fil'm't	1/5	1/10	2/3	3/-	4/10	8/-	12/-	—	—
	Metallic „	—	3/3	3/6	4/-	7/2	9/8	12/-	16/-	20/-

nominal C.P. (*i.e.*, N English C.P., instead of N Hefner C.P.) is usually the same. The high-C.P. metallic-filament lamps are very little more costly than the carbon-filament lamps of equal C.P., and the former have almost entirely supplanted small enclosed arc lamps. In general, arc lamps are the most economical artificial illuminants when units of 500 C.P. or more can be employed (see also fig. 8).

The usual costs of complete Nernst lamps and of Nernst burners alone are as follows:—

Current capacity, amps.	¼	½	1	1½	3
Approximate C.P. (see also fig. 9)	50	100	210	300	500-600
Cost complete	5s.	20s.	20s.	55s.	60s.
Cost of burner alone ...	1s. 6d.	2s. 6d.	3s.	Three of 2s.	Three of 3s.

The cost of arc lamps of given type and current capacity varies very greatly with the maker, with the type of control adopted, and with the general strength of parts and quality of finish. The data of Table VII take these variables into account as far as is possible. Where *quantities of lamps* are to be purchased *these costs may be reduced by* 20 *per cent.* Table VIII, under the same conditions and limitations, shows the usual cost of the more important accessories of arc lamps (excluding hoisting gear, &c., which has already been dealt with under "Poles," section (*c*)).

Interest and Depreciation.—Five per cent. per annum is a reasonable interest allowance on the above capital costs. Depreciation charges are less easily determined; reasonable averages are:—On main cables, 3 to 4 per cent.; on branch circuit cables, 5 to 6 per cent.; on switchgear, 5 to 10 per cent.; on poles, 5 per cent.; on lanterns, 5 to 10 per cent.; on arc lamps about 10 per cent. (determined by obsolescence as well as deterioration); on resistances, chokers and miscellaneous accessories, 5 to 7 per cent.

TABLE VII.

Type of lamp.	D.C. Single carbons.	D.C. Twin carbons.	A.C. Single carbons.	A.C. Twin carbons.
Open.				
3—8 amperes... ...	£3 15—£4	—	£4—£4 10	—
8—15 „	£4 10—£6	—	£4 15—£6	—
Mean, 10 burning hours	£4 10	—	£4 10	—
„ 20—30 „ ...	—	£5—£6 10	—	£5—£8
„ 50 „ ...	—	£8 10	—	—
Enclosed.				
1½—2 amperes ...	£2	£2 10	£2 5	£3
3 „ ...	£2	£3 0	£3 0	£5
4½ „ ...	£3	£3 15	£3 10	£4 5
5—6 „ ...	£3	£5 0	£4 0	£6
8 „ ...	£4—£4 10	—	£5—£5 10	—
10 „ ...	—	—	£5 10	—
Mean	£3 10	£5 0	£4 10	£5 10
Flame.				
Mean, 8 burning hours	£6 0			
„ 10 „ „	£6 10			
„ 12 „ „	£7 0			
„ 16 „ „	£7 10			
„ 20 „ „	£8 0			
„ 30 „ „	£10 0			

D.C. and A.C.

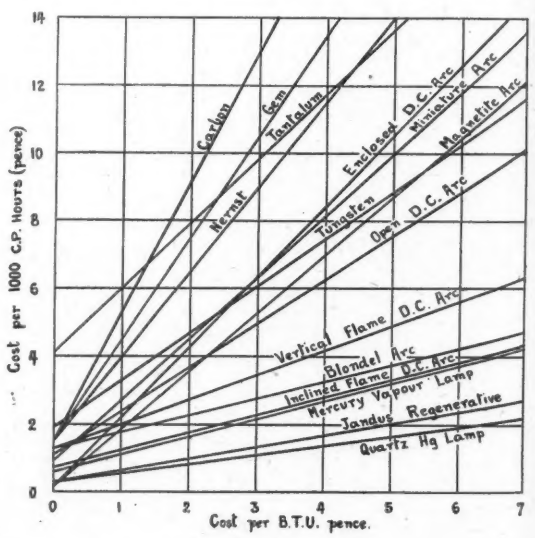


FIG 8.

2. *Renewal Charges.*—The present net costs of various incandescent filament lamps have already been given (Table VI). Table IX gives some idea of the useful and ultimate life of various filament lamps; it should be noted that it is advisable to run Nernst lamps till failure of the glower occurs. Nernst ballast resistances usually last 1,000 burning hours. Owing to their non-blackening properties, tungsten lamps may be run till failure, but tantalum and carbon lamps should not be run long after the C.P. falls below 75-80 per cent. of its original value. The data of Table IX taken in conjunction with fig. 5 and Table VI show the allowance to be made per annum for glow lamp renewals. Notes have been made in the previous section regarding arc lamp depreciation.

The life of carbon lamps is very dependent on the efficiency at which the filament is run and on the maximum excess voltages to which it is subjected. How great this variation in life may be is shown by the following data:—

Efficiency (watts per C.P.)	Life (till failure). On constant voltage.	On 4 per cent. above normal voltage.
4·5	2,200 hours	1,300 hours
4·0	1,550 „	850 „
3·5	1,000 „	600 „
3·0	600 „	380 „
2·5	300 „	200 „
2·0	150 „	95 „

3. *Carbon Costs.*—The carbon costs per annum for a lamp of given type and current capacity depend on the quality of the carbon employed, on the burning hours for which the lamp is designed and on the care with which pieces of broken carbons, positive stumps and so on are utilised. The type of lamp naturally exercises the most profound influence on the carbon consumption per hour, and on the cost per annum. The less free the access of air to the arc, the less the wastage of carbons by mere burning.

TABLE VIII.

Line resistance. For use in pedestal.	Weather proof.	Choker.	Safety coil or substnl. resistance.	Transformer.	Main solenoid.	Globes. Inner.	Globes. Outer.
Open lamp.—							
10s. to 20s. up to 30s.	£1 to £2	£2 5 † 10 amp.	Safety coil (A.C.)	£3 to £7	10s. to	—	7s. to 10s. (round) 10s. to 15s. (oval)
Enclosed lamp.—							
20s. to 30s.	Circa £2	25s. to £2 (4 to 6 amps.)	About 30s. Subst. resis.‡ (D.C.)	8 to 20 amps. 40 to 100 cycles per sec.	15s. (mean)	1s. to 2s.	2s. to 4s.
Flame lamp.—							
10s. to 40s.	£1 10 to £2 10	£2 5 (10 amps.)	£3	1 to 4 amps.	—	2s. Economisers, 6d. each.	5s.

* 5s., if contained in lamp case. † 10s., if contained in lamp case.

‡ If long-series groups of lamps (*e.g.*, 40—50 in series, as in American practice), substitutional resistances are unnecessary, the rise in pressure across the terminals of the remaining lamps, occasioned by the extinction of a few of the group, being quite immaterial; a simple cut-out switch is then all that is required.

The annual cost of carbons depends to some extent, and frequently to a very considerable extent, on whether the current supply is direct or alternating. Though, for the same length of carbons, the burning hours of A.C. lamps are shorter than those of D.C. lamps, the annual cost is usually somewhat less in the case of the former owing to the lower temperature of the carbon tips (and hence less mere burning away), and to the smaller, and hence cheaper, carbons employed (see Table X and fig. 10). Alternating-current arc lamps are usually of higher current capacity than direct-current types (owing mainly to the lower C.P. per ampere of the former; see figs. 3 and 4).

The carbons for enclosed arcs are usually both solid (whether A.C. or D.C. supply), otherwise both are cored; the positive of D.C. open arcs is cored and the negative solid, or both carbons may be solid; both the carbons of A.C. open arc lamps are cored, as also are the carbons of D.C. or A.C. flame arcs. The diameter of the carbons in lamps of given type and current capacity varies somewhat according to the maker, but the curves of fig. 10 form a reasonable basis for general estimating purposes, and will be found to agree with the practice of all leading arc lamp manufacturers.

Arc lamp carbons may be divided into three grades, the best of which costs from two to three times as much as the cheapest. The finest grade is used in interior lighting where extreme steadiness of burning is essential; the intermediate grade is used for less important interiors, or for special exterior lighting; the third grade is suitable and generally employed for street lighting. This grade, while still of good quality, is subject to occasional sputters or flickers in burning; in most streets such are quite unimportant. In Table X are given the net costs per 1,000 ft. of the cheapest reliable carbons, of various types and sizes suitable for street lighting; these data, together with fig. 10 and the subsequent paragraphs, enable the rapid estimation of annual carbon costs.

TABLE IX.—Life and Mean Efficiency of Filament Lamps

Type of lamp.	Useful life (20 per cent. fall in C.P.) D.C.	Useful life (20 per cent. fall in C.P.) A.C.	Ultimate life (till failure) D.C.	Ultimate life (till failure) A.C.
Carbon (see also text), hours	1,000*	1,000*	up to 1,500	1,500
Mean watts per C.P. ...	4	4	4	4
Tantalum, hours	700†	500†	up to 1,000	700
Mean watts per C.P. ...	1·7	1·7—2·0	1·8—2·0	1·9—2·2
Tungsten, hours	1,500	1,500	up to 2,500	2,500
Mean watts per C.P. ...	1·2—1·4	1·2—1·4	1·2—1·5	1·2—1·5
Nernst, hours	520‡	260‡	750	700
Mean watts per C.P. ...	1·9§	2·2	2·1	2·4

* For lamps with frosted bulbs, reduce this life by 40-50 per cent.

† Reduced life on A.C. here due to mechanical disintegration of filament.

‡ Reduced life on A.C. here due to electrolytic decomposition of filament.

§ During the first few hours of their life Nernst lamps may show an efficiency of 0·88 watt/C.P. with horizontal glowers, and 1·4 watts per C.P. with vertical glowers.

The life of Nernst ballast resistances is about 1,000 hours.

TABLE X.—Net Carbon Costs—per 1,000 feet.

Dia. mm.	Enclosed. Solid. £ s. d.	Enclosed. Cored. £ s. d.	Open. Solid. £ s. d.	Open. Cored. £ s. d.	Yellow flame.* Ordinary core. £ s. d.	Yellow flame.* Metal core. £ s. d.
5.	1 2 0	1 2 0	1 2 0	1 2 0	2 0 0	3 0 0
7.	1 13 6	1 13 6	1 5 6	1 5 6	2 12 0	4 4 0
9.	2 8 0	2 8 0	1 12 0	1 12 0	3 12 0	5 12 0
11.	3 0 0	3 0 0	2 0 0	2 0 0	4 18 0	6 18 0
13.	3 18 0	3 18 0	2 8 0	2 8 0	6 8 0	8 8 0
15.	4 8 0	4 8 0	2 16 0	2 16 0	7 12 0	—
17.	5 12 0	6 4 0	3 10 0	3 16 0	10 0 0	—
19.	6 12 0	7 4 0	4 4 0	4 12 0	12 10 0	—
21.	8 0 0	8 16 0	5 4 0	5 12 0	—	—
25.	12 0 0	13 5 0	7 4 0	7 16 0	—	—

* Add 10 to 12½ per cent. to these costs for white flame carbons.

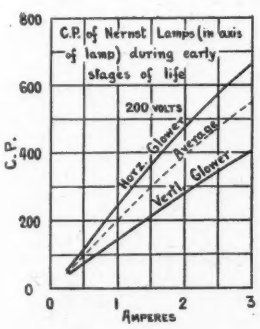


Fig. 9.

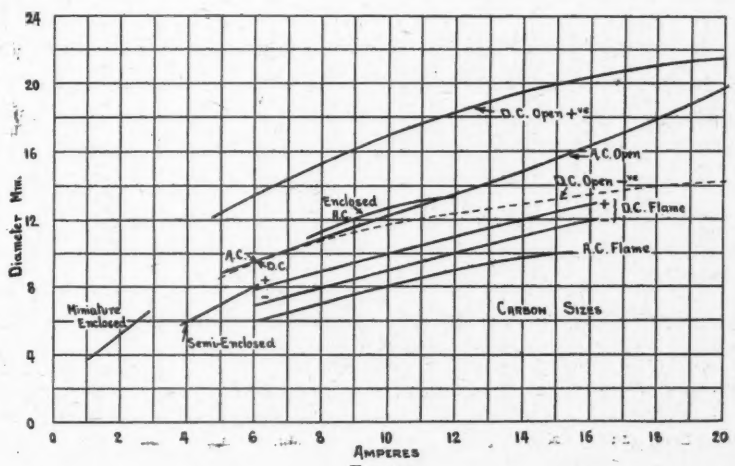


Fig. 10.

The usual "burning hours" (*i.e.*, hours of burning before re-trimming becomes necessary) of various types of arc lamps are as follows:—

Open Arcs.

Single carbons	From 10 to 20 hours
Twin carbons (long-hour pattern) ...	From 30 to 60 hours

Enclosed Arcs.

Single carbons (short-hour patterns)	From 30 to 40 hours
" " (ordinary patterns)	From 70 to 100 hours
Twin carbons	From 100 to 200 hours up to 300 hours

Flame Arcs.

Single carbons	From 8 to 15 or 20 hours
Two pairs carbons	From 15 to 30 hours.

It is not advisable to employ enclosed arcs having longer burning hours than 100-150 hours, since by the end of this time the interior of the globe requires cleaning (or very inefficient operation results); under such conditions, re-trimming involves practically no added expense. When desired, the burning hours of any given type of lamp can be somewhat extended, though at the cost of efficiency, by using larger carbons or reducing the terminal voltage at the lamp; legitimate means of increasing the burning hours are by using longer carbons (involving a longer lamp) or harder carbons (the latter course will again entail a lower efficiency, though the carbon cost will be reduced, "retort" carbons being cheaper than "soot" carbons).

The carbon consumption per hour depends not only on the quality of the carbons but also on their diameter (the consumption being proportionately less in the larger sizes) and *very greatly* on the degree of enclosure of the arc. The figures given in Table XI are reasonable averages; the low consumptions in the case of enclosed lamps can, however, only be secured if proper enclosure be obtained. Negligence, even in so apparently small a detail as the size of the carbon guide-ring in enclosed lamps, to the extent of ½ mm. excess clearance, may increase the carbon consumption 5 to 10 fold.

From the information of Table XI and a knowledge of the burning hours per annum (see fig. 5) the total annual carbon consumption at once follows. In a well managed system considerable economies may be effected by the

TABLE XI.—Carbon Consumption per Hour.

	Upper.		Lower.		Total.	
	mm.	in.	mm.	in.	mm.	in.
D.C. open arc.—						
Soot carbons	13·8	0·55	15·2	0·60	29·0	1·15
Retort carbons	12·3	0·49	11·6	0·46	23·9	0·95
Average	12·6	0·50	12·6	0·50	25·2	1·00
A.C. open arc.—						
Both carbons cored ...	14·9	0·59	16·7	0·66	31·6	1·25
Lower carbon solid ...	13·7	0·54	14·3	0·56	28·0	1·10
Enclosed arc.—						
Both carbons solid ...	1·8	0·072	0·8	0·032	2·6	0·10
Both carbons cored ...	1·1	0·044	1·2	0·047	2·3	0·09
Flame arc.—						
D.C. plain carbons ...	—	—	—	—	86	3·4
D.C. coppered carbons ...	—	—	—	—	68	2·7
D.C. metal-cored carbons...	—	—	—	—	89	3·5
A.C. metal-cored carbons...	—	—	—	—	64	2·55

systematic utilisation of "stumps"; it is increasingly common to arrange that the remainder of the positive carbon can be inserted in the negative holder when trimming the lamp, thus involving *one* new carbon per trim. In other cases stumps may be utilised in lamps at other parts of the system, or at the central station, where more frequent trimming is but a slight objection.

As a rough guide it may be taken that the annual carbon cost, exclusive of labour of trimming and so on, should be:—

For Open arcs	From 15s. to 30s., rising to 40s.
Enclosed arcs ...	From 4s. to 10s., rising to 20s.
Yellow flame arcs ...	From £3 to £4, rising to £5.
White flame arcs ...	From £3 10s. to £4 10s., rising to £5 10s.

4. *Energy Costs.*—The wattage of metallic-filament lamps is very frequently stamped on the lamp bulb, this being an increasingly common method of rating (though not desirable as the sole rating). Nernst lamps are usually rated by their current capacity, whence their wattage at once follows, but carbon-filament lamps are still generally denominated by their candle-power alone. Hence the desirability of the efficiency data included in Table IX; its use enables the determination of the wattage corresponding to any particular C.P. as obtained by a given lamp.

The wattage of arc lamps depends on their current consumption, on the manner of their connection, and on the voltage of supply. The wattage consumption of the arc + all series resistance must be considered in the present connection, so that—

$$W = \frac{V}{n} \cdot C,$$

where W = wattage here required, V = voltage of supply, n = number of lamps in series across V volts, C = current consumption of the group.

By far the greater number of British systems have now 200-250-volt supply, most having also 440-500-volt circuits; the remaining systems usually supply at 100-120 volts, the high-tension circuits then being 220-volt, and in nearly all cases street-lighting arc systems are run off the highest available supply pressure. Tables III and IV show the terminal voltages required by various patterns of arc lamps and the usual grouping on various supply pressures; Table IVA shows the average current capacity of the several types of lamp at present in commercial use.

As an average of some 150 cases (all British systems), the mean price per B.T.U. for ordinary lighting is 4·7d.; the corresponding charges for street lighting and power are 2·7d. and 2·0d. per B.T.U. respectively. These values are shown in fig. 1, which also represents the relationship existing between the prices per unit for lighting and power and for ordinary domestic lighting for various values of the latter tariff. The power rates here referred to are those charged to fairly small power users; large works and other bulk consumers can usually arrange special and much lower rates.

5. *Attendance Costs.*—These are so variable that little can be done by way of forming a general estimate of their magnitude. In many works arc-lamp systems are installed, and skilled labour being ready to hand, and all the lamps being within a small area, the labour costs for trimming and cleaning are almost negligible. Street systems are, of course, much less favourably situated; the cost of mere inspection is now appreciable, and the trimming labour cost depends on the burning hours and type of lamp, on the distance apart of poles, and on the general shape of the arc-lighted district; it also depends on whether the lamps are lowered to the ground for trimming or whether lattice "towers" are used; in the latter case the height of poles has an influence on the labour cost. As a rough guide, it may be taken that with open or flame arcs 10 minutes is spent, either every day or every other day, per post; enclosed arcs need about 15 minutes per post once a week. Allowing 20 to 25 posts per mile (in important streets more will be required), the time to be allowed per pole for collecting tools, cloths, &c., and walking to the next pole is about 2 to 3 minutes. Two men, or a man and a boy, will be required in each cleaning party, and the labour required is moderately skilled.

The attendance charges in filament-lamp systems are much less, and merely cover periodical inspection, cleaning lantern panes, and renewal of broken lamps. Miscellaneous repairs must be allowed for in both the above cases.

These notes may be relied upon as fairly representing average current practice and conditions in street lighting. Naturally, universal applicability cannot be secured, but the author hopes and believes that this information, the collection of which has proved a sufficiently difficult and tedious matter, will be of value to many of his fellow-engineers.

COSTS UP TO DATE.

By INTERESTED.

"Can you give me the cost of our new extensions up to date, showing the amounts already expended on the different sections?" Some few years back, when that question was first put to me by my chief, a kind of a cold shudder passed over my body at the mere thought of wading through many papers and books in order to collect the various sums. Now, thanks to a better system of cost keeping, the information can be obtained in a few minutes. It is all very well to await the completion of any large job before being able to arrive at the actual cost of same; but how often some folks are disappointed with results. On occasion, the total cost of some work exceeds the estimate, and then much time, and sometimes temper, too, is wasted in going through time sheets, cost sheets, &c., in connection with the job to find out where the excess has taken place. But it is too late then to correct any waste, whether such be time or material. By a few minutes' extra work, and a little paper or a few cards, this annoyance, and now and again loss, can be avoided, and the cost can be seen from week to week as the work progresses.

The following short description of one method may prove of some little service to others. It is not a detailed description of a whole system, but only sufficient information to show just how the figures relating to the cost of any work may be so arranged as to show at a glance, almost at any time during the progress of same, the total from the commencement, as well as the amounts expended on the different sections.

In the first instance, each workman makes out a weekly time sheet, or the foreman does so for him, and sets out thereon details of work on which he has been engaged during the week, showing the number of hours spent on each portion of the job. A job-order number is given to any section of which a separate cost is required, in order to save a deal of unnecessary writing. These are forwarded to the office (say) on the Thursday evening every week for the purpose of making up the wages, and also for abstracting therefrom the sums to be allocated to the various sections. All goods used or taken from the stores are booked out by the storekeeper in his issues book, and also in the man's job-order book, which bears a number corresponding to his check. Every man has one of these books, which is placed in a book-rack near by the time recorder or time checks, and in it he enters his hours of work from time to time on the opposite page to that on which the goods are booked, and the foreman enters instructions here also as to what work the man must proceed with when finished with the present job. Two sets of books are in use at one time: one set each week. The goods entered in these books are transferred weekly, or as often as may be desired, together with the wages from the weekly time sheet, to the cost cards. One card is made out for each job-order number representing a portion of the work.

From these cost cards the total of any section can be obtained by just totting up the wages and material columns, but to get at the total cost, as well as the sectional totals, from the commencement, necessitates a special card or sheets and a few minutes' extra work. All the same, the information obtained is well worth the trouble. The card may be arranged as follows, and in order to make the illustration more intelligible, the card is shown in two halves, with some imaginary figures filled in. No. 1 shows the weekly figures transferred from the job-order cards, and No. 2 gives the totals for labour, material, sundries, &c., on each section from the commencement, also the total of the whole lot. Of course, entries could be made daily, weekly, monthly, or arranged in any way to suit the requirements of any particular job.

The advantage of this arrangement is that an eye can be kept on the figures as they grow, and any waste or extraordinary expense is checked before it has grown too large. The extra trouble and small additional expense for stationery is nothing compared with the benefit obtained by watching the cost of a job as it proceeds.

Job.—Laying H.T. Feeder in North Street. Estimate.—£1,506.

Weekly Entries.

Week ending	Job order No.	Labour. £	s.	d.	Material. £	s.	d.	Petty cash and sundries. £	s.	d.	Totals. £	s.	d.
Jan. 2/10	2,016	12	8	3	375	4	0	0	4	10	387	17	1
	2,017	7	6	9	518	10	4	0	7	3	526	4	4
		19	15	0	893	14	4	0	12	1	914	1	5
Jan. 7/10	2,016	1	10	6	13	9	3		—		14	19	9
	2,017	10	14	11	365	6	10	0	5	8	376	7	5
	2,018	5	2	2	14	8	1	0	3	6	19	13	9
		16	7	7	393	4	2	0	9	2	411	0	11

First Half.

Totals from Commencement.

Description.	Labour. £	s.	d.	Material. £	s.	d.	Petty cash and sundries. £	s.	d.	Totals. £	s.	d.
Trenching and conduits	12	8	3	375	4	0	0	4	10	387	17	1
Cable and jointing up	7	6	9	518	10	4	0	7	3	526	4	4
	19	15	0	893	14	4	0	12	1	914	1	5
Trenching and conduits	13	18	9	388	13	3	0	4	10	402	16	10
Cable and jointing up	18	1	8	883	17	2	0	12	11	902	11	9
Draw boxes	5	2	2	14	8	1	0	3	6	19	13	9
	37	2	7	1,286	18	6	1	1	3	1,325	2	4

Second Half.

Patent Restoration.—According to a notice in the *London Gazette* of November 25th, an order has been made restoring Letters Patent No. 14,851 of 1906 granted to Kjobenhavns Telefon-Aktieselskab for "Improved apparatus for the automatic distribution of the operating service in telephone exchange."

REVIEWS.

Elementary Telegraphy. By H. W. Pendry. London: Whittaker & Co. Price 2s. 6d.

A certain individual whom it is usual to credit with wisdom to an abnormal degree, is said to have given vent to a remark some time ago in which he bewailed the apparent lack of finality in the making of books. So far as the present reviewer's experience goes, that remark holds good at the present time, especially as regards books on telegraphy and telephony. It almost seems that books on one or other, or both of the subjects, appear weekly, but they are, most of them, no doubt justified, for this particular application of electrical science, albeit one of the oldest, if not the oldest, application, continues to thrive, grow and become rejuvenated day by day. It is a strange fact, too, and one which, could one but fathom it, may not be entirely without some psychological significance, that the majority of such books are written, not, as one would most naturally expect, to chronicle the progress made in the science, or for the guidance of others interested therein, but rather to help more or less juvenile or other aspirants for honours to pass one or other of the many examinations which are held from time to time. This condition of affairs appears to exist in many professions, and one is led to inquire whether, at this advanced stage of our civilisation, the race is not becoming affected, or at least influenced, by some similarity of circumstances with that peculiarity of Orientalism which gave rise at a somewhat earlier period to the examination system of the Chinese.

Mr. Pendry's book is a contribution to the examination literature of the subject which we feel must be ungrudgingly welcomed, as, although the author says a lot which has been said before, he says it in a new way, which is always sufficient excuse for the appearance of a new book on an old subject, as even threadbare ideas and thoughts clothed in novel diction may reach and appeal to many who could not be edified by the manner in which such ideas have previously been expressed. Further, forasmuch as this book is the latest to appear on the subject, it contains much information which has not been published before.

The reviewer experienced a distinct sense of pleasure in reading Mr. Pendry's book. His writing is good, and what he has to say is very clearly expressed. The evolution of the formulæ to which he introduces the student, and the way in which he shows the derivation of each factor, show him to be a careful teacher. In fact, the book shows evidence of much more careful thought than one finds in many other books of the same type.

The volume is written specially for the needs of those studying for the ordinary grade of the City and Guilds examinations. It includes an introductory chapter on units and formulæ, chapters on Batteries, Lines, Telegraph Systems and Telegraph instruments; and to each chapter is appended a series of questions bearing on the subject matter dealt with therein. Some 17 pages are devoted to that most recent and economical development of the Morse system—viz., central battery systems. In these, the author describes direct and omnibus circuits, duplex circuits, Wheatstone circuits, all worked from a battery at one office, and a central battery repeater, whereby two stations, many miles apart, are enabled to communicate with each other

by means of but one battery fixed at some intermediate point.

The illustrations are from good blocks, but the diagrams, although perfectly clear, are not, in some cases, quite so well drawn and lettered as the general appearance and printing of the book would lead one to expect.—R.M.H.

Calculations in Telegraphy and Telephony. By H. P. FEW. London: S. Rentell & Co. Price 2s. net.

Some time ago we published a review of an earlier book by the same author, in which these subjects are treated from a point of view rather different from that taken in the present case. Mr. Few certainly recognises the desire of all students, not only to show their knowledge to the examiner, but to show it in the way most acceptable to them. In this book Mr. Few takes as his text a rather plaintive wail uttered by certain examiners in one of their recent reports, to the effect that in past City and Guilds examinations but a small percentage of students were able to cope with questions involving even an elementary mathematical knowledge. The author, therefore, sets out in the present book (which is uniform with his previous one) to help students to achieve something like facility in handling problems involving calculation; wherefore we find in its pages many of those cherished little knotty ones so dear to the heart of every examiner who endeavours to ascertain the extent of the student's knowledge—or lack of it—for it is not always clear which purpose is in the mind of many examiners or writers of questions. However, be that as it may, our author should presently earn the gratitude of examiners to the extent that his efforts should at least enable them to adopt a happier tone in their reports, and no less the gratitude of students in that he affords them an opportunity to frame their answers in the style which he adopts in his model answers to questions, the like of which occur year by year.

The book is divided into five sections dealing separately with questions in both subjects, from the ordinary, honours grade, and miscellaneous examinations held from 1900 to 1910, and all the solutions are fully worked out in detail, so that any student who is not in a position to avail himself of a qualified teacher should find the book particularly useful.

Perusal shows that all time-honoured stock problems, beloved of examining boards, with their apparently unlimited variations, such as joint resistances, joint capacities, bobbin windings, stresses on poles, stays and wires, batteries (with their subtly regimental methods of grouping, such as one is glad to be spared in ordinary life), are fully treated. *Apropos* of the latter, may we say that we once heard of an experienced examiner, who was so obsessed with the multitudinous variations of this little pet problem, that, having become tired of forming fours, sixes and eights, &c., with various numbers of cells with all sorts of impossible E.M.F.'s and resistances, and, moreover, deeming that should this problem fail to appear on examination papers, the whole electrical world would cease to revolve, he retired, and is said to have spent the remainder of his life somewhere in the neighbourhood of Hanwell, with his whole mind—or what was left of it—concentrated upon an attempt to frame a question in which one cell was to be grouped in divers ways with itself. We believe that his end was not altogether a peaceful one.

It is observed that Mr. Few has dealt with the questions in datal order, and that, therefore, variations of the same questions are scattered throughout the book. Doubtless a convenient arrangement for the author, but one which, the reviewer thinks, cannot be so convenient to a student, whose studies would be more consistent were all questions of the same nature grouped together. An arrangement such as this would have added not inconsiderably to the utility of a very useful book.—R.M.H.

Light Railway Orders.—The B. of T. has confirmed the Portsmouth and Hayling Light Railway (Extension of Time), and the Weston-super-Mare Junction Light Railway Order.

THE MANCHESTER STEAM USERS' ASSOCIATION REPORT.

THE annual report of this Association has just been published, and contains some useful matter. In the first place, there is a revised copy of the well-known boiler-house poster of advice to boiler attendants.

One bit of advice is that mechanical stokers should not be used with forced draught if the water is sedimentary or greasy, or otherwise the furnaces are almost sure to bulge or groove. Such bulging is apt to be slow, whereas collapses from shortness of water are sudden. There is no harm in repeating the advice for hot furnace plates—viz., to cool both sides by opening the doors, without disturbing the fires, so as to pour much cold air through the furnace, and to close the stop valves of other connected boilers and ease the safety valves of the distressed boiler so that priming may take place in it and thus quench the hot plates by the rising froth. All feed should also be turned on. Experiments have shown that no increase of pressure results. As a fact, if so much of a furnace crown has become sufficiently hot to raise steam enough to markedly raise the pressure, the furnace plate would already have collapsed.

It is a piece of needed caution to keep open the safety valve before loosening any manhole or mudhole cover. Not merely should the lever be raised; the valve itself must certainly be off its seat, for the weight of the valve is quite sufficient to retain so much steam that when a manhole cover is lifted there will be a scalding outrush of steam. This will happen whenever the brickwork is still hot and there is a little water left in the boiler. The blow-off is properly shut to prevent another form of scalding, and it would, perhaps, be good practice to fit a 1-in. cock on every boiler to be opened before a manhole is loosened, so as to ensure exactly atmospheric pressure inside the boiler. Obviously, the water gauge cocks might be used for this purpose, but they are not so used. A simple cock on the boiler crown, or front, or on the manhole cover would be more insistent as a warning, and it ought to have a chained rod for thrusting through in order absolutely to prove that the steam space is open to the air.

A special paragraph is given to steam pipes. "Cracking noises in steam pipes indicate water and an explosion may occur at any moment."

The various paragraphs of brief advice are explained in subsequent pages. Thus, if a boiler is hot above and cold below, the difference being 270° F., stresses of 10 tons per square inch intensity may be engendered. Such stresses added to the existing steam stress may be dangerous, in fact, are dangerous. They produce the familiar seam rips, which in the Lancashire boiler, were only prevented from being disasters by the presence of the strong flue tubes.

Where there are other boilers, a newly filled boiler should be warmed by a steam jet, but such are rarely fitted, or a boiler may be filled nearly full, and when the upper water has attained a temperature of 212°, the blow-out opened and the cold bottom-half blown out, so that the upper, hot water, now occupies the boiler bottom.

It costs, say, £500 a year to supply coal to a Lancashire boiler, £25 a year to fire it if there are other boilers fired by the same man; £10 to overhaul and clean, and £2 to inspect it. These figures show how foolish it is to economise on the three small items when the large item is so serious and so easily made larger by carelessness in the other items. Yet steam users will haggle over a few shillings a year in their boiler insurance premium, when they might often save the same number of pounds of fuel in a week by attention to the advice they receive, and neglect to follow.

A few words are said as to the iniquitous system of coal money paid—quite openly now, it is true—by coal merchants to stokers. It says much for the honesty of the stoker that he does not deliberately fire badly in order to get bigger "coal money." The system ought to be stopped, and firemen better paid.

The section of the report which deals with smoke is well worth study, though it is to some extent a plea for allowing black smoke, on the ground that if fines are inflicted more coal may be burned, and the worst evil of coal combustion, namely, the sulphur compounds, will be increased. But this ignores the fact that suitable furnaces will use less coal than smoky furnaces, and so make less sulphur compounds. Unfortunately, the correct form of furnace, though known, is ignored by most users of water-tube boilers, these boilers being probably the worst smokers with ordinary furnaces, but the most easy to fit with good smokeless and economical refractory furnaces.

Waste gases cannot be washed unless at least one-third the amount of the feed water is used, so that the result may be dirty water not hotter than 212° F. This, of course, means a forced draught of some sort which may increase costs by 5 per cent. The remedy for the impasse is, of course, the discontinuance of open combustion, such as would be brought about by the gasification of coal in closed producers, the recovery of the ammonia as sulphate, the reduction of the sulphur to acid by which to treat the ammonia and the use of the desulphurised gas in internal combustion engines. Such a system has been long enough before us all. Now that a President of the Institution of Electrical Engineers has foreshadowed its future possibilities, there may be some chance of men giving it a thought and ultimately of its adoption.

Is not the report in error in stating that no mechanical stoker has yet adopted the system of side firing on the alternate method? Was there not a stoker made in Blackburn which did this? *Apropos* of the danger of opening a manhole when the boiler is above or below atmospheric pressure, it is remarked that the power

for mischief of a vacuum space equal to an ordinary Lancashire boiler is equivalent to the power of one stroke of a marine engine having a low-pressure cylinder of 120 in. diameter. The ss. *Adriatic* has two L.P. 112-in. cylinders. Regarding feed water, it is hinted that the beneficial effects of sewage in boiler feed water are due to the absorptive effect on oxygen.

Common salt in even small percentages is found to neutralise the benefit of soda, and even to cause pitting when they are present together. No explanation of this has yet been forthcoming. There is some extremely interesting matter on corrosion.

Makers of various steam containers often possess little knowledge of the stresses which occur in their ill-designed productions. As might be expected from Mr. Stromeyer, there is considerable discussion of steel, which is summed up in the rejection of all Bessemer steel for boiler purposes, only open-hearth steel being admissible, and that with not over 0·06 per cent. of phosphorus. This would shut out a good deal of foreign steel.

Altogether this report is an excellent one, and worthy of the chief engineer of the Association.

CORONATION ELECTRICAL ILLUMINATIONS.—FIRE BRIGADE PROPOSALS.

THE minutes issued for Tuesday's meeting of the London County Council contained the following references to the precautions that are considered desirable by the Fire Brigade Committee in connection with electrical street illuminations which are expected to be very extensive on the occasion of King George's Coronation in June, 1911 :—

We have considered the question of the precautions that should be adopted for minimising the possible risk of fire from the arrangements that may be made for the street illuminations on the occasion of His Majesty's Coronation in June, 1911. On the occasion of the Coronation of King Edward VII in 1902, the chief officer of the Fire Brigade drew attention to the considerable risk of fire that might attend the arrangements for the street illuminations, and by our direction a circular letter was sent to all the electric supply authorities in London drawing attention to this risk, and suggesting that special care should be taken with the illuminations. Having regard to the rapid development and extension of electric lighting during the past 10 years, it is probable that the illuminations next year will be on a very much larger scale than on the previous occasion, and judging from the inquiries already made of the Council, it appears that electric lighting will be extensively used for the purpose. While the Council, however, has no power to make any regulations in the matter, we think it would be advisable to take some action similar to that taken in 1902, and the chief officer of the Fire Brigade has, with this object, drawn up the following suggested list of precautions, based on the experience obtained in connection with the electrical arrangements at theatres and music halls, exhibitions, &c. :—

1. All installations should be inspected, tested and approved by the local supply authority before connection is made, and any installation that has not a satisfactory insulation between poles, and between either pole and earth, should not be connected.

2. All circuits and sub-circuits should be provided with properly proportioned fuses to each pole: and sub-circuits should be limited to a maximum of (say) two kilowatts each, and should be arranged with due regard to current density in the conductors.

3. No bare conductors should be used, and all conductors within reach of the public should be specially protected by suitable conduits; and all metal conduits or coverings should be efficiently "earthed."

4. All switches, fuses, terminals and connectors should be protected from effects of weather and from possibility of mechanical injury.

5. Festoons, garlands, &c., containing lamps should be provided with means of support independent of, and insulated from, the conductors, and should be secured in such a manner as to minimise risk of injury from wind.

6. All shades and decorations of combustible materials in proximity to lamps should be rendered non-inflammable by a process which will withstand the action of rain for several days, and no shades or decorations of celluloid or similar substance should be used.

7. The installations should be connected, where practicable, at the main intake or at the main distribution boards, so as to avoid the possible overloading of the house wiring.

"We think that a copy of this list should be forwarded to all the local authorities and companies supplying electricity in London, and also to newspapers which deal specially with electrical matters. We venture to express the belief that the supply authorities and the Press would welcome such action, and would co-operate with the Council in the matter. We suggest that action should be taken at this early stage, as we think that the giving of long notice will be to the advantage of all concerned, and will further tend to lessen the risk if the Council's suggestions become widely known.

"It is not proposed that the Council should take any responsibility in the matter, since, apart from the question of the Council having no direct jurisdiction, detailed inspections by the Council would be necessary, and this would be impracticable, having regard to the fact that the installations would be fitted only a few days before the date of use; but a system of inspection such as could be organised by each supply authority for its own district and in its own interest would be of great advantage in reducing the fire risks, which, in crowded resorts and thoroughfares, might otherwise be serious. We recommend that the attention of the local authorities and companies supplying electricity in London be drawn to the advisableness of taking steps to minimise the risk of fire that may attend the arrangements for street illuminations on the occasion of His Majesty's coronation in June, 1911, and that such authorities and companies be supplied with a list of precautions drawn up by the chief officer of the Fire Brigade; and that the newspapers which deal specially with electrical matters be informed of the action taken."

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SEYCHELLES ISLANDS.—No certificates of origin are required for goods imported, but it must be stated on the bill of entry whether the goods are the produce of the United Kingdom or of some British Possession or not. Invoices and bills of lading for imported goods are required to be produced to the Customs Authorities.

The following goods are admitted free of duty :

Articles imported for the use of the Administrator; machinery not elsewhere specified. Machinery when using crane is dutiable at the rate of 2·50 rupees per 1,000 kg. Goods not specially mentioned in the tariff pay a duty of 12½ per cent. *ad valorem*, the value of goods for duty purposes being the value as shown on the original invoices. The Customs Officers have power to examine the goods to see that they agree with these invoices in value and to call in expert evidence.

No telegraphic or electric station, apparatus, machinery or implements whatsoever, whether for the purpose of electrical communications by what is known as "wireless telegraphy," or for any other purpose connected with the transmission, &c., of messages between the Seychelles Islands, and places outside, may be erected without sanction from the Governor.

SIAM.—A duty of 3 per cent. *ad valorem* is levied on goods imported.

SIERRA LEONE.—Invoices should show the marks, numbers, and descriptions of packages, together with the value of the packing materials in which the goods are enclosed. The quantity and description of the goods themselves, together with their value at the place of purchase, and the shipping and other charges, should also be specified on the invoice. The invoices need be in no special form, but the headings showing names, addresses and designations, should invariably be printed. The production of invoices for all imported goods is required. The Customs Law states that the *original* invoices, showing the cost of the articles at the place at which they were purchased, must be produced, but in practice "original" invoices, *i.e.*, the invoices of the original sellers, are not demanded. Certificates of origin as such are not required for imported goods, but importers are required to make a declaration as to the country of origin on the bill of entry.

Electrical and industrial machinery and apparatus, mathematical and scientific instruments, and all *bona fide* telegraph materials landed for the use of the African Direct Telegraph Co., are admitted free.

No person may establish or use any apparatus or installation for the purpose of electrical communication by wireless telegraphy, or operate wireless telegraphs, without previously obtaining a licence from the Governor of the colony.

TARIFF AMENDMENTS.

FRANCE.—The French Customs authorities have published their decision that apparatus for registering the consumption of electric current shall be dutiable as electrometers at the rate of 75 fr. per 100 kg.

UNITED STATES.—The United States Customs authorities have decided that belting composed of cotton and india-rubber, the india-rubber having the chief value, shall be dutiable at the rate of 60 per cent. *ad val.*

Inspectors of Mines.—In the House of Commons on Wednesday Mr. Churchill, in reply to a question, said he had decided to establish a new branch of Sub-Inspectors of Mines and Quarries. He proposed to create 30 of these posts, and the salary of the men engaged would be £150 a year, rising by annual increments of £5 to £200. He also proposed to appoint 12 more Junior Inspectors, and to make permanent a temporary appointment which would have come to an end this year. This would augment by nearly 50 per cent. the number of the existing staff.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

26,375. "Improvements connected with switch points of electric tramway and like rails." G. SALTER. November 14th.

26,390. "Means for and method of obtaining continuous currents from alternating-current circuits and *vice versa*." A. M. TAYLOR. (Application for Patent of Addition to No. 20,867 of 1909.) November 14th.

26,393. "Improvements in dynamos." E. R. FREEMAN. November 14th.

26,399. "Improvements in electric lamps." F. W. LANCHESTER. November 14th.

26,400. "Improved electromagnetic flux induction clutch." J. G. BALSILLIE. November 14th.

26,401. "Electric current generating and motive power machine." W. S. FROST. November 14th.

26,404. "Improvements in the manufacture of a metallic medium for electric lighting." F. H. FEARNS. November 14th.

26,420. "Improvements in or relating to devices for controlling the speed of electric motors." ADAMS MANUFACTURING CO., LTD. (Cutler-Hammer Manufacturing Co., United States.) (Application for Patent of Addition to No. 13,406 of 1910.) November 14th. (Complete.)

26,439. "Improvements in or relating to devices for controlling the speed of electric motors." ADAMS MANUFACTURING CO., LTD. (Cutler-Hammer Manufacturing Co., United States.) (Application for Patent of Addition to No. 13,406 of 1910.) November 14th. (Complete.)

26,440. "Improvements in and relating to telephone systems." E. BOWMAN. November 14th. (Complete.)

26,451. "Improved support for telephone instruments." J. R. SOWERBY. November 14th.

26,462. "Device for protecting the ears and trolley wire on electric railways and tramways." H. McP. DUDGEON. November 15th.

26,465. "Improvements in electric ovens." B. THOMAS and E. THOMAS. November 15th.

26,478. "Improvements in and connected with electrical welding machines." BRITISH INSULATED AND HELSBY CABLES, LTD., and P. BUCHER. November 15th.

26,542. "Improvements in electric batteries especially adapted for train lighting." E. J. CLARK. November 15th.

26,546. "Improvements in the electrolytic manufacture of glycolic acid." G. W. JOHNSON. (Deutsche Gold and Silver Scheide Anstalt vorm. Roessler, Germany.) November 15th.

26,568. "Improvements in electrolytic cells for the electrolysis of alkaline salts." M. WILDERMANN. November 15th.

26,591. "Improvements in and connected with electric wires or cables." BRITISH INSULATED AND HELSBY CABLES, LTD., and E. A. BAYLES. November 16th.

26,619. "Improvements in and connected with electric light for advertising purposes." A. E. HAWKER. November 16th.

26,627. "Improvements in electric current controlling devices or switches." W. K-L. DICKSON. November 16th.

26,642. "Improvements in or relating to elements for generating or storing electricity." N. H. M. DEKKER. November 16th.

26,667. "Improvements in and relating to electric incandescent lamps." E. R. GROTE. November 16th.

26,685. "Improvements relating to the compensation of polyphase commutating dynamo-electric machines." ALLGEMEINE ELECTRICITATS GES. (Date applied for under Sec. 91 of the Act, November 16th, 1909, being date of application in Germany.) November 20th. (Complete.)

26,696. "Improved fastener for lids of train lighting accumulators." W. N. COCHRANE. November 17th.

26,702. "Improvements in or relating to the driving gear of electric motor-driven vehicles having independent axle drives." E. J. NEACHELL and J. A. PANTON. November 17th.

26,729. "Improvements relating to magneto-ignition apparatus." F. B. LODGE and A. M. LODGE. November 17th.

26,737. "Improvements in automatic electric tumbler switches." C. W. DENNY and W. H. FLOOD. (Application for Patent of Addition to No. 26,570/09.) November 17th. (Complete.)

26,747. "Improvements in mounting the electrodes of metal-vapour apparatus." HARTMANN & BRAUN AKT.-GES. (Date applied for under Sec. 91 of the Act, December 1st, 1909, being date of application in Germany.) November 17th. (Complete.)

26,761. "Improvements in the treatment of minerals containing carbonate of copper." MUREX MAGNETIC CO., LTD., and K. A. F. ROBERTS. November 17th.

26,782. "Device for utilising the heat of the sun by converting it into electrical energy." F. JOH and J. WOLF. November 17th. (Complete.)

26,836. "Improvements in and relating to electric heaters." M. B. FIELD and FERRANTI, LTD. November 18th.

26,854. "Improvements in and relating to intercommunication telephone systems." STERLING TELEPHONE AND ELECTRIC CO., LTD., and G. BURNEY. November 18th.

26,880. "Improvements in dynamo-electric machines." W. HOLT. November 19th.

26,892. "Improved means for electrically igniting miners' safety lamps." J. PRESTWICH. November 19th. (Complete.)

26,906. "Improvements in the electrolytic refining of copper." S. O. COWPER-COLES. November 19th.

26,907. "Improvements in the electro-deposition of copper." S. O. COWPER-COLES. November 19th.

26,909. "Universal angle-grip for cord of electrical-holders." A. J. CHAPMAN and H. E. MASON. November 19th.

26,959. "Improvements in two-fluid galvanic cells." W. J. HESSELN. (Date applied for under Sec. 91 of the Act, February 11th, 1910, being date of application in Germany.) November 19th. (Complete.)

Hornsey.—The following tariff for power supply, optional to the present charges, has been adopted: Day supply, for power only, for certain approved classes of load, and to certain apparatus, 1d. per unit, through a clock switch, in such manner that current is cut off on peak load. Power rate for domestic purposes, for each kilowatt of apparatus installed, a fixed charge of £3 15s. per KW. per annum, paid in advance as follows: For each winter quarter, £1 10s.; for each summer quarter, 7s. 6d.; or, if paid in advance for one year, £3 per annum. All units consumed to be charged at ¾d. per unit.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909

ELECTRO-MOTORS AND THE PRODUCTION OF SOUND-WAVES FOR SIGNALLING TO A DISTANCE. S. Evershed, W. D. Kilroy and Evershed & Vignoles, Ltd. 16,895. July 20th.

CONSTRUCTION OF ELECTRIC LAMP HOLDERS. R. Sheward. 23,634. October 15th. (Post-dated April 15th, 1910.)

CABLE CONNECTIONS FOR ELECTRIC BURGLAR-ALARMS AND THE LIKE APPARATUSES. A. Bloch. 24,076. October 20th.

ELECTRIC POCKET IGNITER. F. Diemel. 24,180. October 20th.

ELECTRICAL CONDUITS AND ACCESSORIES. L. Milne. 24,561. October 26th.

ELECTROLYTIC APPARATUS FOR THE PRODUCTION OF PURE OXYGEN AND HYDROGEN. R. Eycken, C. le Roy and R. Moritz. 24,716. October 27th. (Date applied for under International Convention, December 9th, 1908.)

ELECTRICAL HEATING APPARATUS. A. F. Berry. 24,813. October 28th. (Cognate application, No. 29,954 of 1909.)

ELECTRIC HEATING APPARATUS. A. Trepreau. 24,829. October 28th.

ELECTRIC DRIVE FOR RAILWAY VEHICLES. Akt.-Ges. Brown, Boveri et Cie. 24,843. October 28th. (Date applied for under International Convention, December 18th, 1908.)

DYNAMO-ELECTRIC MACHINES OR ELECTROMAGNETIC POWER DEVICES. A. Smith and T. Good. 25,144. November 1st.

DIRECT-CURRENT ELECTRIC MOTORS. R. Lecoche. 25,230. November 2nd.

ELECTRIC ARC LAMPS. H. Hirst and A. E. Angold. 29,069. December 13th.

1910

DRIVING GEAR FOR IGNITION MAGNETOS AND SIMILAR DEVICES. S. Parsons. 3,125. February 8th.

ELECTRIC CABLES. Siemens Bros. & Co. and W. Dieselhorst. 3,818. February 16th.

MEANS FOR OPERATING TRACK POINTS ON ELECTRIC TRAMWAYS OR THE LIKE. R. Fanning and M. Nellis. 5,823. March 12th.

MAGNETO-ELECTRIC IGNITION MACHINES. Firm of Robert Bosch. 6,653. March 16th. (Date applied for under International Convention, May 10th, 1909.)

DYNAMO-ELECTRIC MACHINES. A. Meynier. 10,208. April 26th. (Date applied for under International Convention, April 26th, 1909.)

TERMINALS FOR ELECTRIC CABLES. Firm of Robert Bosch. 11,600. May 10th. (Date applied for under International Convention, July 23rd, 1909.)

WINDINGS OF DYNAMO-ELECTRIC MACHINES. Allgemeine Elektricitäts Ges. 14,862. June 20th. (Date applied for under International Convention, June 21st, 1909. Request under Sec. 19 of the Act not granted.)

COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 19,539. August 20th.

CONTROL APPARATUS FOR VAPOUR ELECTRIC DEVICES. H. M. Scheibe. 1,483. January 20th. (Date applied for under International Convention, January 21st, 1909.)

ARC LAMPS. R. Blackwell. 2,263. January 28th.

ELECTROMAGNETIC APPARATUS FOR BURGLAR-ALARM AND LIKE SYSTEMS. A. Bloch. 2,824. January 29th. (Date applied for under Rule 13, October 20th, 1909.)

INSULATORS AS USED ON THE OVERHEAD WIRES OF ELECTRIC TRAMWAYS AND RAILWAYS AND THE LIKE. H. H. Dudgeon. 4,716. February 25th.

ALLOY FOR USE IN THE MANUFACTURE OF ELECTRIC SOLDERING TOOLS OR OTHER APPARATUS HEATED BY OR STANDING UNDER THE INFLUENCE OF AN ELECTRIC ARC. Regina-Bogenlampenfabrik Ges. 6,523. March 15th. (Date applied for under International Convention, May 4th, 1909.)

ELECTROLYTIC APPARATUS HAVING A LIQUID ANODE. S. Schott and A. Gen. 6,597. March 16th. (Date applied for under International Convention, March 30th, 1909. Application for Patent of Addition to No. 14,288 of 1909.)

ELECTRICALLY OPERATED LOCKING MEANS FOR THE DOORS OF STRONG ROOMS, LARGE SAFES, AND THE LIKE. M. Dobson. 6,915. March 18th.

ELECTROMAGNETICALLY CONTROLLED ELECTRIC SWITCHES. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 7,465. March 24th.

MEANS FOR STARTING ALTERNATE-CURRENT MERCURY-VAPOUR LAMPS. Firm of W. C. Heraeus Ges. 8,125. April 24th. (Date applied for under International Convention, January 17th, 1910.)

GALVANIC BATTERIES. Dura Elementbau Ges. and A. Lessing. 8,810. April 12th. (Application for Patent of Addition to No. 23,622 of 1904.)

METHOD OF WORKING ARC LAMPS IN SERIES WITH INCANDESCENT LAMPS. A. Heimann and W. Schaffer. 11,581. May 10th. (Date applied for under International Convention, August 2nd, 1909. Application for Patent of Addition to No. 747 of 1910.)

PROCESS OF OXIDISING NITROGEN BY MEANS OF ELECTRIC DISCHARGES. R. Kaiser. 12,229. May 19th. (Date applied for under International Convention, May 19th, 1909.)

ELECTRIC SWITCHES. H. E. Dey. 12,489 and 12,490. May 23rd. (Date applied for under Rule 13, October 21st, 1909.)

Post Office Insulators.—Mr. C. Duncan recently asked the Postmaster-General what percentage of the total number of insulators ordered for telegraph and telephone purposes during the last four years have been of the leadless glaze variety; what difference exists in cost; what step has been taken with a view to increasing that percentage in view of the findings of the recent Departmental Committee on Lead Poisoning; and what will be the percentage of the total likely to be ordered in view of the increased activity consequent on the transfer of the telephone service to the State?—The Postmaster-General replied: The most recent experiments of the Post Office engineers show that, unfortunately, the leadless glaze insulators are less efficient for telegraphic and telephonic purposes than the insulators with lead glaze, and cannot, therefore, be used on long-distance lines; for that reason only about 20 per cent. of the insulators ordered by the Post Office during the last four years have been leadless glazed. The actual number is 4,600 gross out of 23,700 gross. I regret that on account of the technical difficulties to which I have referred I have not felt myself justified in increasing the proportion to more than 30 per cent. of leadless and 70 per cent. of lead-glazed. Of the firms employed, only one now quote a higher price for leadless than for lead glaze, and the difference in their case is 1s. per gross.